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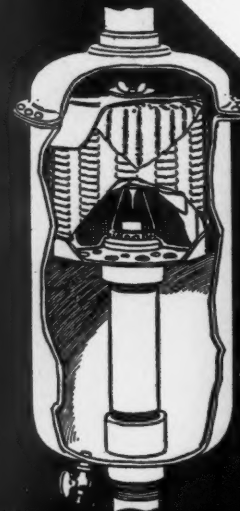
PROTECTOMOTOR



MODEL CP PIPE LINE FILTER

Machines Run 3 to 5 Times Longer without Repairs

The purchase of a compressor, Diesel engine or blower means a big investment. Is it worth trying to save the small cost of an air filter and let the dust and grit in unfiltered air wear and score the cylinders, pistons, bearings and valves and thereby cause excessive repairs? Or even worse, is it worth saving a few dollars by installing an ordinary so-called air cleaner which will pass more than 300 times as much dirt as a Protectomotor?

Machines will operate 3 to 5 times longer before overhauling is necessary when equipped with a Protectomotor, because it removes 999 of every 1,000 particles of dust and grit from the air. That has been proven by tests made by the University of California and other reliable sources.

Furthermore, the Protectomotor Air Filter cuts carbon deposits 60 to 70%, saves oil and compressed air, and muffles exhaust noises.

The Protectomotor passes air through a dry filter medium of negligible resistance. It operates from six months to a year without cleaning, and can be cleaned with compressed air without removing the filtering unit.

This filter has no moving parts—no cleaning tanks or solutions. Requires no duct work, roofing baffles or adhesives. For oil engines, it is completely self-contained and weather-proof, and can be mounted in any position inside or outside of power house.

Clean, white filtering element before being placed in service on machine.

After few weeks' service, showing dust, sand, grit and dirt kept out of machine.

Protectomotor Pipe Line Filter

delivers dry, clean air, free from dust, water, oil, rust and scale, for compressed air tools, paint spraying, hoists, cleaning operations, agitating liquids, etc.

Let us send you a filter on free trial. If it does not convince you that it will save many times its cost, it may be returned for full credit. Mail the coupon.

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As It Seems To Us

NEW YORK OPENS ANOTHER SUBWAY

ONE of the world's major engineering and construction undertakings has been placed in commission with the opening of the Manhattan section of New York City's new subway system. More than seven years have elapsed since work on it began—a longer period of time than will be required to rear the Hoover Dam. The skeleton has been ready for many months, however, and the delay in opening the line has been due chiefly to inability to find anyone willing to run it under the prescribed terms. A 5-cent fare is mandatory for the first three years of operation. Failing to secure private bidders for the privilege of running its railroad, the city early in 1932 appropriated $700,000 to finance municipal operation. The essential equipment has been in place for the greater part of a year, and trains without passengers have been run to keep the rolling stock in service condition.

The new underground railway increases New York's preëminence as regards subways, and raises the combined trackage of its local transit facilities to more than 2,000 miles. Including extensions into Brooklyn and Queens, which are not yet completed, the new system represents expenditures of approximately $800,000,000. Considering only this first cost, it will require 16,000,000,000 riders at five cents each to pay for the construction. This is equivalent to some 2.600 trips by each resident, or to the total patronage of all New York subway, elevated, and surface lines for five years.

The new subway was built in sections of from one to three miles long by a number of private contractors. It includes both open-cut and rock-tunnel types of construction along the land right of way, and subaqueous bores beneath the East River to connect with sections which are not yet open. It gave employment to thousands of men for several years. The Manhattan section parallels three existing sets of tracks from midtown to the lower end of the island; but so many millions of persons move in and out of this corner of the Metropolis in the course of a day that New Yorkers still expect to have to scramble for seats during rush hours.

HYDROGENATION OF CRUDE OIL AN ACCOMPLISHED FACT

IN OFFERING the motoring public a new lubricating oil, the Standard Oil Company of New Jersey announces that the hydrogenation process has been successfully applied to the refining of crude oil. After spending some $25,000,000, and devoting several years to research and to the development of plant facilities, the company is able to produce a high-grade lubricant at a cost that is in line with that of established methods of refining.

For the present, lubricating oil will be the only product of hydrogenation to reach the market; but it is stated authoritatively that a long list of petroleum derivatives will later come from the two plants at Bayway, N. J., and Baton Rouge, La. Among these products will be a line of solvents for use in the paint, varnish, lacquer, soap, and textile industries; a fuel for aircraft and motorboats that is more fire-resisting than any now avilable; a special aviation-engine lubricating oil; and a substitute for benzol. A superior kerosene has already been produced—in fact, one of the plants made it exclusively for five successive months during the past year to supply a sudden demand.

The virtue of hydrogenation is its flexibility. It makes possible 100 per cent recovery of gasoline from crude oil or fuel oil, and the conversion of coal, oil shales, and other carbonaceous materials into petroleum and its products. Thus the recurring prediction that underground oil reserves will soon be depleted no longer forebodes a calamity. In times of emergency, ammonia, nitric acid, and explosives could be produced in such plants as are now operating.

This new process comes to the United States by way of Germany, where all the initial development took place. Any refiner of oil in this country of sufficient size to use hydrogenation commercially may do so under a royalty agreement. More than 90 per cent of the companies that fall in that class have already made arrangements to secure the required operating rights. It is expected that hydrogenation will eventually supplant the methods of refining now in general use.

MINERAL PRODUCTION DECLINES

ACCORDING to estimates by the Bureau of Mines, the value of mineral products of the United States, including petroleum, was approximately one-third lower in 1931 than in 1930. The decrease was due both to the drop in prices of most minerals and to the sharp decline in production. The figures reflect the poor general business conditions that prevailed and reveal, in turn, why fewer miners and fewer rock drills were at work. Despite the reduction, the sum total of mineral production was more than $3,000,000,000, which is equivalent to $25 per capita.

With gold proportionately more valuable than in prior years, and with thousands of men combing the hills and valleys of the nation for ore, nuggets, and flakes, the output of the yellow metal rose 5 per cent. The gold miner had one of his infrequent innings, and made the most of it. Silver did not fare so well, and along with iron, copper, zinc, lead, and other base metals bore the brunt of the mining inactivity. Chromite and tungsten were about the only metals other than gold to show improved figures. Tungsten production doubled, but, even so, was less than 1,000 short tons. Metallic minerals as a whole accounted for only about one-sixth of the total output.

Because of proration and falling prices, the output of petroleum decreased by 47,000,000 barrels and brought half a billion dollars less than in 1930. Coal made a better showing than oil, but still a poor one in comparison with banner years. Cement and stone both felt the lethargy of building activity.

ELECTRICITY AND HEALTH

THE TIME may be near at hand when every medical college of standing will include a course in the rudiments of electricity in its curriculum. Just as we now have a combination technical and legal man in the patent attorney, so are we likely soon to have the medico-electro specialist to cope with certain ailments to which the flesh is heir.

The chemical laboratory has been a staunch ally of the physician for some time now. Through it misinformation concerning the human body has been converted into accurate knowledge, and that knowledge has, in turn, been broken down into its components. We have learned that flesh, bone, and blood are composed of definite proportions of certain kinds of matter. Test tube and beaker inform us what is lacking and what is overabundant in any one of us. From laboratory research we know that various forms of energy are required to keep the human mechanism in top shape. The chemical doctor has isolated and identified many of these, and we now eat those foods that will supply the particular vitamins, or energy units, that we need.

Physicians are turning more and more to physical therapy. Sun bathing is in favor—reverting in a measure to ancient practices; and the baths and massages the Romans relied upon to tune up their bodies are advocated today. Modern medical men use X-rays, radium rays, ultra-violet rays, and infra-red rays, and have applied electrical current with such success as to indicate that it may become an important aid to the physician and surgeon of the future. A few weeks ago, at the American Congress of Therapy in New York, specialists reported beneficial results from the use of high-frequency current in the treatment of cancer. In many cases these results are said to have surpassed anything that could be accomplished with the knife.

Physical medicine, we are told, is the application of physics to medicine. Thus does science contribute again to mankind's welfare.

HIGH above the Colorado River these workmen are placing anchorages from which drillers will swing by ropes in scaling down the walls of Black Canyon

Motive equipment is spick and span, in keeping with the nature of the service the company renders.

Cleansing Clothes for 250,000 Persons

Modern Machinery, Care, and Precision Contribute to the Efficiency of a Laundry Which is Directed by Six Brothers Who Had a Big Idea

C. H. VIVIAN

BUSINESS concerns which have not only held their own during the past three years but actually expanded in the face of all the deterring influences that have exerted themselves are few and far between. When such a one is found we are a little awed; but the pique of curiosity impels us to ask questions which will reveal the wherefores and whyfores of its success.

The Little Falls Laundry Company of Little Falls, N. J., thus comes within our scope. When the ship *Good Times* was being battered by the first blasts of the gale of depression back in 1929, this concern was in the midst of a program of plant enlargement. Increased patronage had made necessary certain additions. These were completed, and business continued to grow better instead of worse. A new department was added, and, a little later, a second one. Plans are now drawn for a $200,000 structure which will still further augment the facilities for serving a constantly growing constituency and for relieving an overcrowded condition.

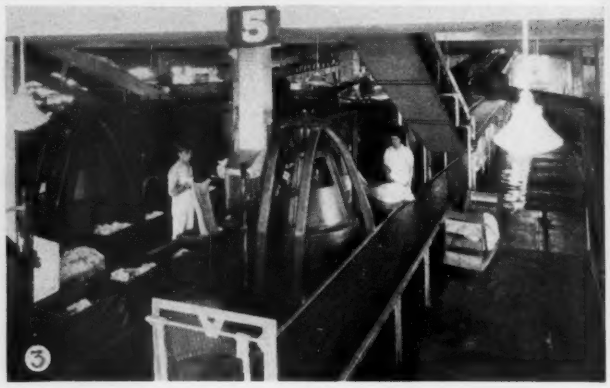
Briefly stated, the good fortune of the company is explained by the fact that the six Van Der May brothers seized upon an idea twenty years ago and have unremittingly developed it ever since. Today they are all still active in the business—each in charge of a specific phase of its conduct, and they are just as enthusiastic about it as they were in the beginning. All of them continue to live in the community they helped to build; and their principal interest in life remains the Little Falls Laundry Company.

The concern has now grown to be one of the world's largest laundries, if not the largest. It serves 50,000 families, representing 250,000 people, virtually the equivalent of the population of Denver or of Louisville. From a community enterprise drawing upon a limited circle it has continually expanded, and now embraces a territory measuring approximately 125 miles in length and more than 50 miles across. About 2,000,000 persons live in this area, and one in every eight is a customer. Some of the larger cities that are served are Newark, Jersey City, and Paterson. In addition to the main office at Little Falls, branches are maintained at East Orange, Plainfield, and Red Bank.

The story of the modest start of this business, which now gives employment to 670 persons, is of absorbing interest. Contrary to the usual order of things, the concern was never a one-man affair for the simple reason that there were six Van Der May brothers and their father, and what one did they all did. One of the sons, Nicholas, then a lad in his early 'teens, had a head for merchandising, and persuaded his father to start him in the huckster business. From the family home in Little Falls he plied the section around Montclair and the Oranges with horse-drawn loads of soil products, which he sold to housewives. As the business grew and the other sons became old enough, each in his turn helped out, and the family made a comfortable living.

The father was satisfied, but not so Nicholas. For Nicholas was an opportunist, although that word was not then bandied about with its current frequency. In covering their routes, the boys were often asked by housewives if they knew of anyone who would wash their clothes and household linens. There seemed to be need for such a service; and, as the requests continued, Nicholas suggested to his father that they do something to meet the demand. Van Der May père thought this was a crazy notion, and he told his son so. They were prospering; and the shoemaker would do well to stick to his last. But Nicholas was not to be put aside so easily. He persisted until the father reluctantly consented to finance the idea in a small way. Thus it was that in 1912 the Little Falls Washing Company was born. In a sparsely equipped 1-story building the seven Van Der Mays cleansed the clothes that they gathered from their friends and vegetable customers. Collections and deliveries were made by horse

The home of the Little Falls Laundry Company.



1—Clothes are first sorted and identification tags are affixed to each lot. 2—They are next conveyed to washers by the upper of the pair of belts. Cleansed clothes are placed on the lower belt. 3—They reach the extractors on the belt at the right, are freed of excess water by centrifugal action, and each lot is placed in a box on the conveyor at the left. The overhead lines supply empty boxes as they are required.

and wagon. To the delight of Nicholas and the surprise of his father the pile of bundles grew larger day by day and week by week. The clothes were washed and returned undried to the housewives for ironing. But as time went on this original "wet-wash" service was supplemented.

Nicholas's conception of the business from the outset was that it should be conducted in such a way that customers would be so well satisfied that they would tell other persons; and the amazing growth of the undertaking is ample evidence that this is what happened. Otherwise the Van Der Mays would probably have resumed huckstering long ago or, at best, remained small launderers. Good will was built up by word of mouth; and, as soon as money was available, the company began to advertise. They have remained firm believers in publicity; and expenditures for this purpose have increased in direct proportion to gross business. In 1926 the name was changed to Little Falls Laundry Company, and the nucleus of the present plant was constructed. This was the third enlargement, additional room having been provided in 1917 and again in 1922. The business is a partnership, and each of the six brothers has an equal voice in its management. In deference to his talents for leadership, however, Nicholas is the general manager.

The Little Falls Laundry Company has become more than a laundry. It not only offers every conceivable kind of service for washable goods but also cleans and reconditions other masculine and feminine apparel, even to hats and neckties. The latest addition is a rug-cleaning department; and when the new building is ready that department will be accorded increased space.

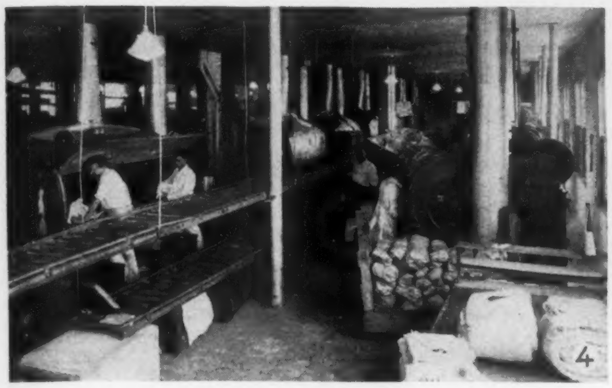
One hundred and seventeen pieces of motive equipment are operated; and their weekly aggregate mileage is equivalent to a trip around the earth at the equator. Most of them are trucks, with which 100 uniformed salesmen make their collections and deliveries. This service has been so well coördinated with the plant schedules that in certain instances patrons at New Jersey seashore points, nearly 100 miles away, may send laundry on one day and have it back the next, if they so desire. The receiving and delivery department is located in one section of the building opening directly off the street, and at certain times of the day there are so many trucks coming and going that a special traffic officer has to be stationed outside the entrance.

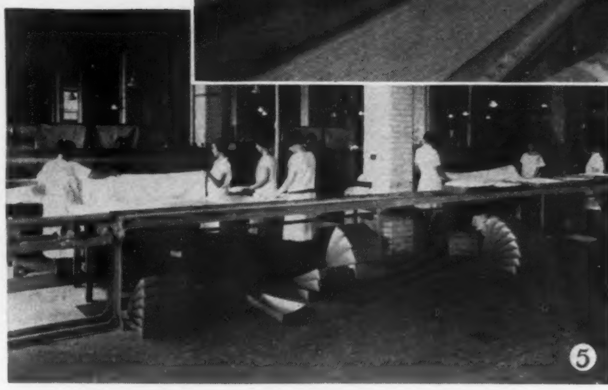
The laundering process is organized along the lines of a modern manufacturing plant. Raw material, in this case soiled clothes, goes in at one end; is segregated according to the treatment it is to receive; travels through the various departments where the several operations performed are often broken down into a series of individual ones; and comes out as separate pieces which are assembled in packages in much the same manner that individual parts are built up into complete machines. The comparison is more than a figure of speech, for in the Little Falls Laundry there is roughly a mile of conveyor, all of it made for a specific transportation service and much of it ingeniously arranged. The laundering activities are carried on in a 3-story building which is equipped with facilities that progressively move the clothes through the plant from the third floor to the first.

To give the reader an idea of how such a laundry functions, let us assume that we have presented a bundle of family wash at the receiving department, and then follow it through the plant, trying the while not to confuse ourselves with too much detail. First of all a record is made of our name and address and of the class or classes of service we want, and a serial number is assigned to our particular bundle. This serves to identify its contents during the trip and, together with cards of different colors, makes sure that the individual pieces not only will receive the several treatments called for by reason of their diverse characters but will also be reassembled in one group after having been necessarily separated.

The bundle, with perhaps a hundred others, is then transported by elevator to the third floor. There it is placed on springless scales and its weight noted. At that point an operator of a keyboarded machine akin to a calculator types a manila tag in triplicate. This bears the salesman's number and route, the customer's serial number, and the weight and price of the laundry. Because we will pay for a then undetermined portion of the contents on a basis of finished work, there may be one or more subsequent weighings, but this initial record is made to conform to state law. One of the tags goes with the bundle, a sec-

The six Van Der May brothers and their father.





4—The "rough-dry" tumblers, where currents of warm air dry the clothes while they are being fluffed. 5—Flatwork is ironed by passing it through delicately adjusted rolls. 6—Finished flatwork and "rough dry" meet on assembly lines for packing after being weighed on the scales in the upper center. Forms for finishing stockings are visible at the right. Shirts, collars, and wearing apparel are finished in other departments.

ond goes to the office, and the third goes to the salesman. Our clothes are now ready to have things done to them.

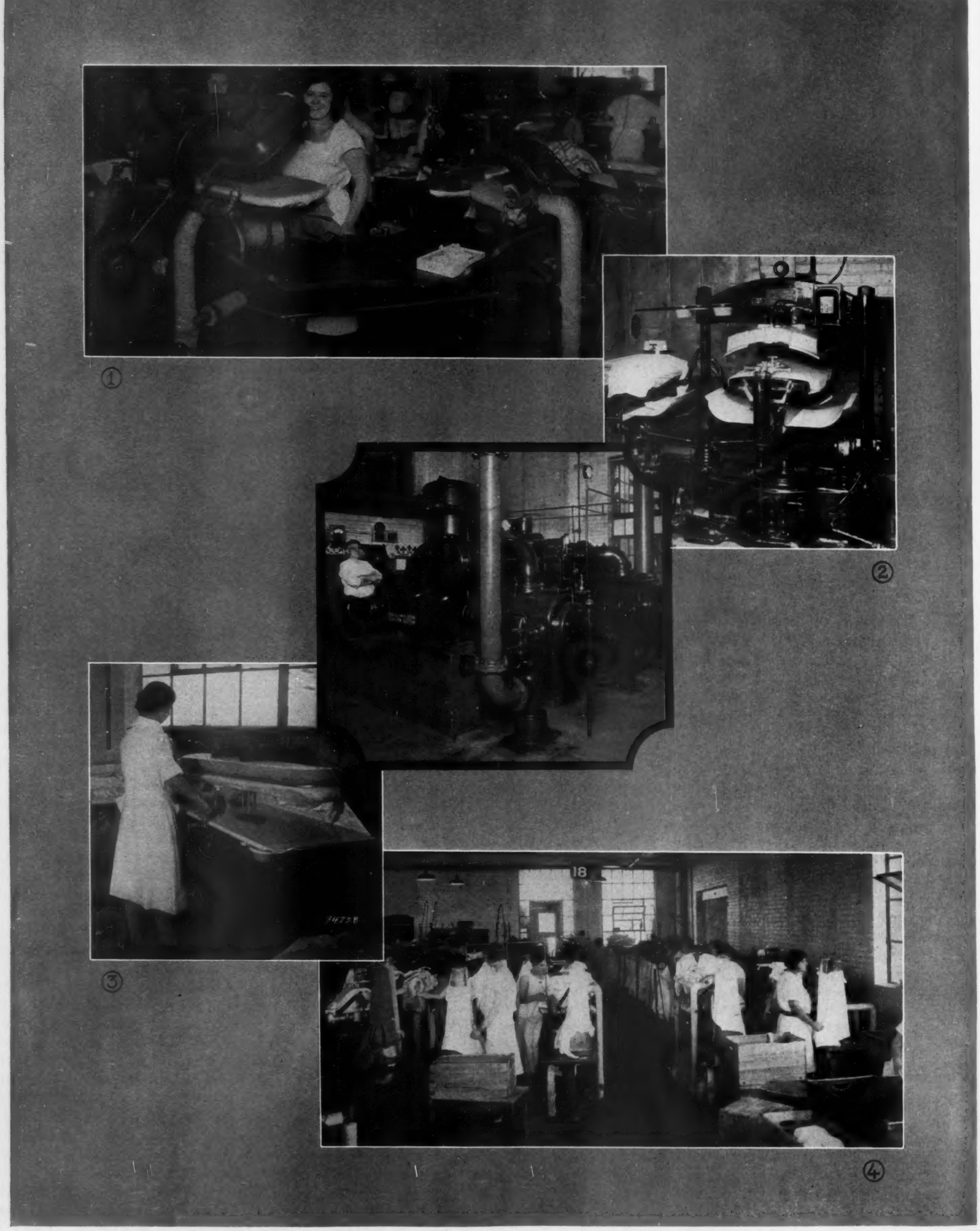
The bundle goes to the sorters, who work in front of tables running almost across the room and divided into compartments for each man. Here the clothes are separated into as many groups as are required because of the various classifications into which they fall and the character of the services that we have designated they should receive. At this point our bundle is given an identification number which will guard its contents from being directed to someone else and which will also insure that all the pieces will be there when it is delivered to our home. The manila tag is attached to a small bar of metal about 8 inches long and of rectangular cross section. Upon this bar are fitted six metal disks or tags slotted keylike to conform to certain raised portions of the bar over which they must pass to slide on or off. Each of these tags and the bar with which they go bear the same number. One of these disks accompanies each lot of our subdivided laundry through the plant. The bar in the meantime has been sent down to the assembling department on a belt conveyor. As each finished lot reaches this point, the identifying pilot tag shows that it belongs to the customer whose ticket is attached to the bar which bears the same number. Human mistakes are immediately adjusted there because, even though the number on the tag be read incorrectly, the tag will fit only on the bar to which it belongs. When all six tags have been returned to the bar it is definitely known that all the lots into which our bundle was divided have gone through the plant. This system averts shortages and mixups in assembling bundles for checking out, and it eliminates the need of using unsightly disfiguring marks. Our serial number is stamped on shirts and collars, as it can be hidden from view and is not objectionable in their case.

The sorter, then, divides our bundle into as many piles as are called for and affixes a means of positive identification to each. Adjacent to the sorting tables are basins of soapy water over each of which is mounted a soft brush in the form of a wheel. This is revolved at a high rate of speed, and by means of it an operator gives the crease lines of shirt collars and cuffs a preliminary treatment which will make it easier to thoroughly cleanse them later without resorting to hard usage.

The various lots of laundry are placed on conveyor belts which move them down one floor and in front of American Laundry Company "cascade" washers. These are cylindrical monel-metal machines, each of which has eighteen compartments. They have no internal stirring or agitating mechanisms, nor do they revolve. They move through an arc of 90°, or a quarter revolution, and then back to the starting point. This serves to impart a sloshing motion to the water and is designed to accomplish the best results with the least possible wear upon the fabrics. The effect is similar to that obtained by sousing clothes up and down in water by hand. Each lot of clothes remains in the washer one hour. From seven to ten changes of water are made, the total water consumption for each lot being more than 600 gallons. Powdered soap and soft water are used for washing. Before a lot is taken from the washer it is thoroughly rinsed and also sterilized with live steam to kill bacteria. In the case of white goods, an application of bluing is added in proper order.

After they are taken from the washer, the clothes are placed in bags of heavy netting and travel by belt conveyor to extractors, which perform the same function as the familiar wringer does in the home on wash day. These are upright, cylindrical, double-walled vessels with perforations in the inner walls. There are 22 of them; and after from ten to sixteen bags or nets of clothes are placed in each extractor, the lid is affixed and the cylinder whirled on its vertical axis at 700 revolutions a minute for ten minutes. This serves to dry the clothes sufficiently for ironing.

The foregoing description applies in general to the treatment accorded each of the lots into which our original bundle was separated, except that each of the different fabrics must be given the particular attention which it requires. For example, assuming that we have included some woolen blankets, these are washed in similar oscillating machines; but the temperature of the water is thermostatically controlled to guard against having it too hot, and the washer rocks back and forth at a slower rate. Following washing, the blankets pass through a machine which brushes them lightly to raise the nap and to restore their fluffiness. Then they are placed



1—Air-operated presses for wearing apparel. The girl in the foreground attends two machines. 2—A shirt-bosom press which presses one garment while another is being placed on the form at the left. 3—A close view of a prim press which shows the manner of control and the air piston below. 4—A corner of the shirt-finishing department, with sleeve-finishing forms in the foreground. The central view shows the Type XRE compressor that supplies air for the various operations.

on frames which hold them to their original size while they are dried in a compartment by blowing warm air through them. Shrinkage is thereby prevented. Curtains are likewise dried on frames; ruffles are fluted by machine; and fringes are hand combed.

To keep them clean, our clothes are placed in a separate wooden box when they are taken from the extractor, and thus they travel on, by conveyor, to subsequent operations. The supply of these boxes is replenished through the medium of overhead conveyors. Sheets go through any one of twelve flat ironers, which consist of long rolls spaced and adjusted with such delicacy that a wet sheet of tissue paper can be passed between them without tearing it. Three girls feed the work through an ironer and three receive it when it emerges on the other side.

That portion of our bundle which calls for "rough-dry" treatment goes to cylindrical tumblers, which are the wash line of the laundry. They are heated by live steam; and, while the clothes are being lightly tossed about in them, currents of warm air are blown through them. The action of these machines is to render fabrics fluffy and even to bring out the nap on bath towels, something which is hard or impossible to accomplish by home-laundering methods.

With the operations upon them completed, flatwork and rough dry come together in the assembling department, each on its own conveyor belt. En route to the assemblers they are weighed. Should our flatwork reach the point of packing ahead of the rough dry, or *vice versa*, it will shuttle back and forth on a conveyor belt until the delayed portion comes along. The finished, inspected pieces are packed in a cardboard box and travel onward to join a second box which contains our shirts, collars, and wearing apparel. Incidentally, the boxes are fabricated in the laundry from flat sheets, cut to proper sizes.

Meanwhile, the other portions of our bundle have been receiving attention in other departments. Wearing apparel goes to a room where 100 American Laundry Company Eagle prim presses are installed. These consist essentially of a stationary ironing board and of an upper member, hinged to it at the back, which comes down to meet the board. They are of various sizes and shapes, designed to perform specific operations. Pressure is applied by a horizontal piston which straightens a vertical, jointed arm at the rear. This serves to raise an extension of the back of the upper board member with which the arm is connected, thereby closing the press and maintaining the pressure until it is released by the operator. The piston is actuated by compressed air at 85 pounds pressure. Some of the presses, formerly operated by other means, were converted to air power, while the newer units were purchased equipped for air operation. These standard machines are now employed by modern laundries everywhere and, as a result, have made compressed air an important and indispensable agency in such establishments. The wearing-apparel department is organized in groups of units each consisting of four machine presses and a hand-finishing board which are attended by three girls.

Shirts are treated in this same room, but on presses of a slightly different type. In their case, a hydraulic piston supplements the action of the air, and the lower of the two pressing members is lifted into position against the upper one. An air pressure of 55 pounds is utilized on these machines. A shirt goes through five separate and distinct operations. First each sleeve is drawn down over a tapering metal form of elliptical cross section which completely fills the arm space, smoothing out the cloth and drying it by means of steam heat applied from within—the edges at either side of the metal form placing light creases in the sleeve as a guide to subsequent folding. Next the collars and cuffs are finished in ingeniously contrived presses. Then the bosoms and backs, in turn, are pressed in special presses. One girl can handle as many as six presses during some of these operations. As a final step, the shirt goes to a hand finisher, who also serves as an inspector. In the packaging department, where the shirts are encased in protective transparent paper having a back and an intermediate layer of supporting cardboard, a machine inserts the wooden collar button which is so familiar to all wearers of laundered shirts. In this laundry, a device is in use that brings French cuffs together and opens the holes in the four layers of cloth so that the alignment is correct for the insertion of cuff links when the shirt reaches its owner. Several interesting mechanical accessories are found in this department. Collars on collar-attached shirts can be turned and resewn in unbelievably short time; and missing buttons are supplied in less than the traditional jiffy.

Repairing the nets in which clothes pass through the plant. The operator, William Story, is considered one of the most efficient workmen despite his 86 years.

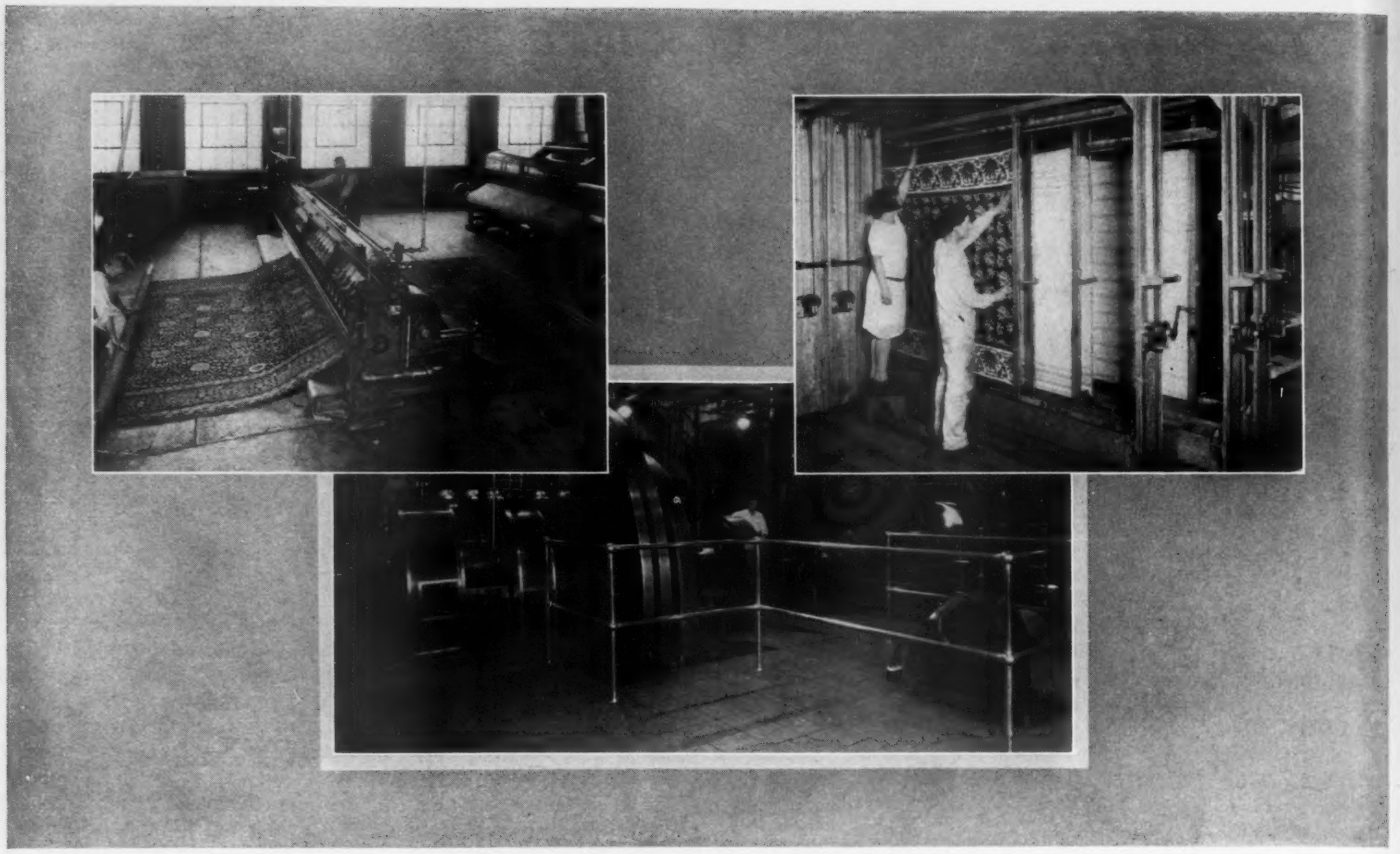
Collars are treated in a separate department and pass through seventeen distinct steps during the process. There are machines for every conceivable purpose; and no detail is overlooked which will improve the appearance of the collar or insure greater comfort to its wearer. Shirts and collars are placed in a cardboard box and sent on their way.

One section of the Little Falls Laundry is allotted to the dry cleaning and pressing of nonwashable wearing apparel and men's hats. Even neckties are cleaned and renewed—in fact, the company is equipped to handle every item of attire except shoes. Articles are cleaned by the Zoric dry-cleaning method under an exclusive process termed the Falco. Carbon tetrachloride is the cleaning reagent; and it is purified by distillation and reused many times. The garments are bathed in this fluid in cylindrical tumblers, each of which is equipped with its still to form a unit. Among the advantages claimed for carbon tetrachloride over petroleum derivatives long employed in dry-cleaning work are the absence of odor, the freedom from oily base substances, and its nonflammability. Until the feature of distillation was introduced, the use of this fluid was precluded because of its high cost. Spots which resist complete removal by this method are taken out by patting them with a brush bearing a suitable reagent.

Men's suits are pressed on the familiar machines now generally found in tailor shops. Pressure is applied by the operator through the medium of a foot pedal, which permits controlling it according to the requirements of the fabric. Live steam is blown through the cloth from the upper half of the press to moisten it and to remove wrinkles, and the moisture is removed by drawing air down through the cloth. This calls for suction in the lower half of the press. In most installations this is effected by means of a steam jet—the rush of steam past the open end of a pipe sufficing to draw air through it and from the surface of the press board with which the pipe connects. In the Little Falls Laundry, compressed air is used instead of steam. The linings of all men's suits are hand ironed, as are women's dresses and other articles that are not adaptable to machine pressing.

The hat-renovating department is equipped with the most modern mechanical aids obtainable; and it is possible there to perform every essential operation, even to reversing a good-quality felt hat to give it a new wearing surface.

Rugs are first passed through a machine



Left—Rugs are gently beaten in the machine at the right and then shampooed mechanically at the left. Center—General view of the power-generating room. Right—Washed blankets are placed on adjustable frames and moved into the compartment at the left for drying by warm air currents.

in which numberless small leather straps, attached to a revolving bar, deliver light taps to remove the dust. Although the action of these straps is so gentle that the hand can be held under them without discomfort, yet the countless number of blows struck accomplish results equal if not superior to those obtained by beating the surface with a heavy instrument, and the same risk of injuring the rug is not incurred. Suction created by a fan at the end of the machine withdraws the dust to a collector. Some large rugs have yielded as much as 25 pounds of dust. The rug is then passed through a shampooing machine where, through the action of many individual soft brushes, the surface is gently scrubbed with a cocoanut-oil lather. The treatment is applied while the rug is stretched over a cylinder, thus opening up the pile so that the brushes get to its base. The machine likewise rinses the rug, after which it is taken into a special compartment for drying. The rapidity of the treatment safeguards the rug against discoloration. It takes only eight seconds for any portion of the rug to pass through the washing process; and it is claimed that it requires 23 seconds for dyes to run.

The Little Falls Laundry Company stresses its use of softened water. This is natural stream water which is pumped into the plant, filtered through sand, and then treated in a Permutit softener which has a capacity of 1,000 gallons a minute. It is said that clothes washed in softened water last one-third longer than clothes washed in water supplied through the average city distribution system. To augment its water supply, the company has just completed driving a well, 600 feet deep, adjacent to the building. Tests conducted by air lift show that it will furnish 216,000 gallons a day.

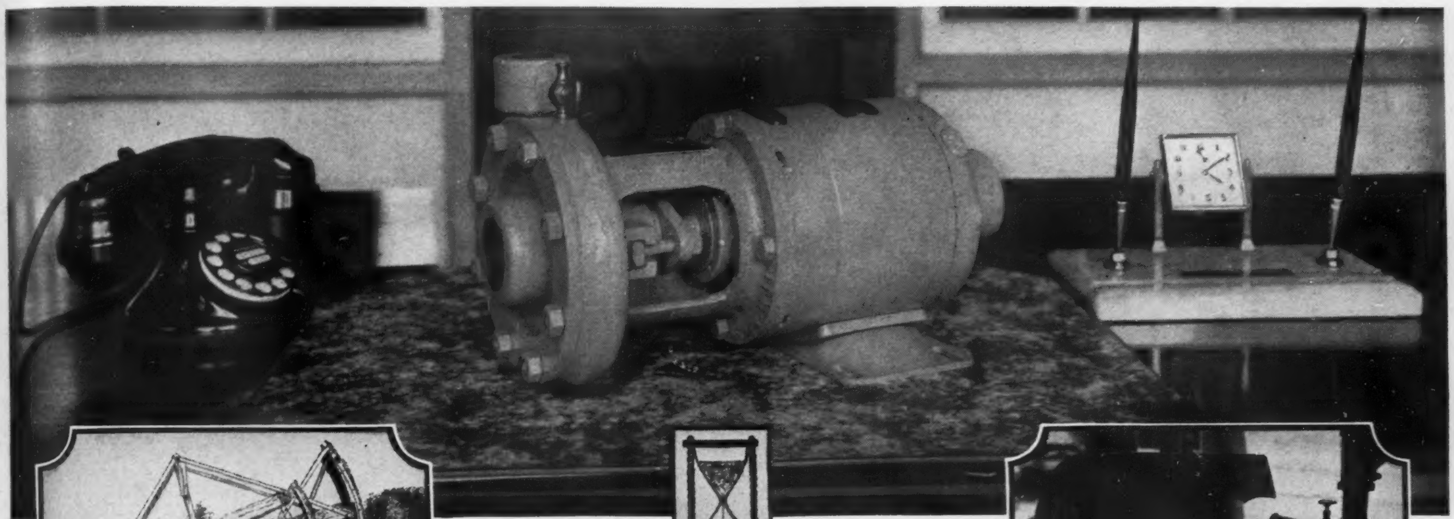
In the belief of the owners, this plant has the largest air-compressor installation of any laundry. Two small units, one steam driven and the other electrically driven, were formerly used; but the need for more air arose, and it was decided to provide one large machine that would carry the normal load. Accordingly, the company purchased an Ingersoll-Rand 15&9¼x12-inch Type XRE compressor, which has a piston displacement of 676 cubic feet per minute. It is direct driven by a General Electric 125-hp. synchronous motor, and is equipped with 5-step clearance control to regulate the discharge volume to the demand for air.

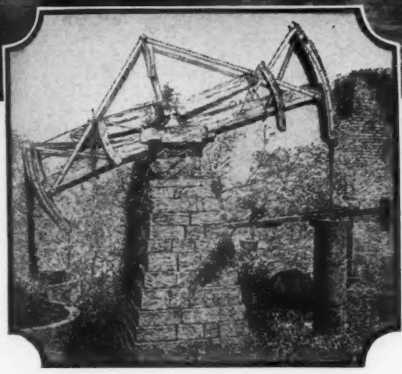
This machine was placed in service the first of this year, and is now operated the greater part of the time. Towards the end of the week when the laundry is not running at full capacity, or when there is need for but a small amount of air in some department that is working overtime, the large unit is shut down and the supply of air is obtained from one or both of the small compressors. In addition to the uses mentioned, compressed air is employed extensively in the garage, which has a force of sixteen men to care for the motive equipment. It is also used for operating tools in plant maintenance work and for cleaning the entire laundry once a week.

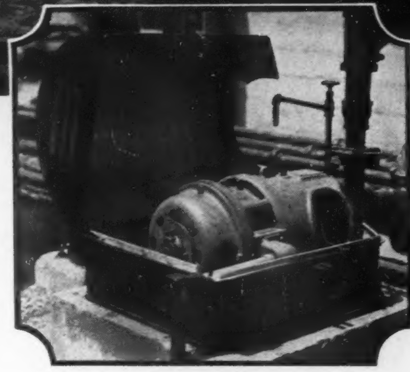
A great deal of electric current is required for the motors that drive the various mechanical features of the laundry, and this is generated on the ground. There are two General Electric, steam-driven, alternating-current generators aggregating approximately 700 kw. in capacity. Steam is supplied by four 320-hp. boilers under which soft coal is burned. Waste heat from the boilers is used to heat the great quantities of water required for laundering purposes. A modern air-conditioning plant is installed; and the temperature in the laundry is maintained at a comfortable degree for working, regardless of outside conditions.

The visitor to the Little Falls Laundry is impressed with the morale of the employees, most of whom seem to have absorbed some of the enthusiasm of the Van Der May brothers. This spirit is manifest both in and out of working hours. The company maintains for its personnel a combination auditorium and bowling alley. A bowling league, with a membership of 60, plays there regularly each winter; and on the stage a minstrel show is presented annually by members of the force. A baseball team recruited from the male workers furnishes popular diversion during the summertime.

The six Van Der May brothers who have built up this business until it has become a leader in its line are Nicholas, Barney, Samuel, Garrett, John, and Herman.







Above—A Motorpump in a setting that aptly emphasizes its small over-all size.

Left—A century ago this was the "last word" in pumps.

Right—A Motorpump that handles gasoline. It has an open motor and is protected against fire hazard by the sheet-metal cover which fits down over it.

Modern Pumps are Small but Mighty

THE illustrations at the top of the page present a striking contrast between early and modern pumps and emphasize the great progress that has been made in reducing the size of pumping units. The Newcomen pumping engine, that is shown on the left, has not operated for more than a century, although in the state pictured it was in existence at Fairbottom, England, a few years ago, and it may still stand there for all we know to the contrary. This form of pump was operated by steam, and was widely used for dewatering English coal mines. The steam cylinder, which had a diameter of 26 or 28 inches and a stroke of about 6 feet, is shown at the left. The cylinder at the right is not the pump cylinder proper, as this was located underground and was operated by direct lift through rods connected with the end of the walking beam.

This ponderous machine was constructed with more weight on the pumping side than on the steam side, so that when steam at atmospheric pressure was admitted under the piston it would rise and the pump bucket would descend. When the piston reached the top of the cylinder the steam was shut off by means of manually operated valves and a jet of water was injected into the steam cylinder to condense the steam and form a partial vacuum. This caused the forcing down of the piston by atmospheric pressure and the consequent lifting of the water. The operation was necessarily slow, and the consumption of fuel enormous.

The upper view graphically illustrates the compactness and small size of the Motorpump, a centrifugal pump mounted on the same shaft and within the same casing as its driving motor. We make no attempt to claim that the two units shown were of equal capacities: the fact is that we do not have performance data on the Newcomen engine. The Motorpump pictured is the smallest size—of ¼ hp.; but other sizes ranging up to 100 times its power take up less than three times its space. Somewhere within this range, it is safe to say, is a pump that will do the work of the old English unit, and even it might be placed on the average office desk with room to spare.

The sight of the two illustrations brings up interesting speculations and tells us much as to why modern industry is so efficient. Visualize, if you will, the difficulties of the salesman of the Newcomen pump in convincing a prospective customer that he should invest in one. He could not carry one around with him, nor had he any photographs to display. Manifestly, the installation of the unit called for much masonry work, and the best he could do in this respect was to exhibit drawings of the requisite structure. Fortunately, his customers were trained to think in terms of massive mechanics. Even though electric current had been available, a salesman who heralded an era of vest-pocket hydraulics, as exemplified by the diminutive Motorpump, would very likely have been put behind bars as a charlatan or magician rather than been given a chance to demonstrate his claims.

Many Motorpumps are used today for transferring gasoline from tank cars to storage tanks, which gives rise to the thought that the huge pump of a century ago would prove as useless for this work as these vast quantities of motor fuel would have been in the economic structure of 1832. Motorpumps can be furnished with open, totally enclosed, or explosion-proof motors. A 1½-hp. Motorpump in the storage yard of a large oil company near San Francisco is illustrated here. The unit has an open motor and, as a precaution against fire hazard, is housed in a sheet-metal case with louvers for ventilation. Through ingeniously arranged piping, this pump transfers gasoline either from tank cars to storage tanks or from storage tanks to tank wagons. The liquid can be handled in either direction between a storage tank and one of the large truck-and-trailer carriers which are extensively employed on the Pacific Coast. The pump is fitted with a pressure-actuated automatic stop-and-start switch. When the several valves in the piping system are properly set, the pump will start as soon as a truck driver opens the line leading into his tank.

Motorpumps are available in sizes of from ¼ to 25 hp. and in capacities of from 5 to 800 gallons per minute. In all, there are more than 40 sizes. These units can handle a great variety of liquids ranging from water to paper stock. They can be had with motors suitable for a wide range of current conditions. The construction of the pump conforms to standards set by units of greater capacity and of much larger selling price.

Construction of the Hoover Dam

A Description of the Methods of Obtaining and Preparing the Aggregates for the 4,400,000 Cubic Yards of Concrete to be Poured

ALLEN S. PARK*

THE sand, gravel, and stone for the 4,400,000 cubic yards of concrete that will be used to construct the Hoover Dam and its appurtenant works will all come from the Arizona Gravel Deposits, a 30-foot bed of alluvial material located about six miles in an air line upstream from the dam site. This lense-like accumulation of silt, sand, gravel, and bowlders was laid down in past years by the Colorado River. Thus the tempestuous stream is in a sense a copartner in the herculean task of bringing it under control. Not only did it oblige man by cutting a deep gash through the lava flows that provides a rock-ribbed anchorage for the great monolith of concrete that will be inserted there, but, as though to make an additional magnanimous gesture, it carried down in countless flood times and left near at hand much of the material that will go to fabricate that concrete plug. In this manner, perhaps, Nature requites for her ravages.

When the Government elected to build the dam, one of the multiplicity of duties that fell to the lot of the Bureau of Reclamation Engineers was that of finding a source of suitable concrete aggregates. That search was carried on actively for a number of months, and many possible sites were examined and reported upon. The Arizona deposits were found to be the nearest source of supply that would yield the character of materials wanted. Vast quantities of rock—hard, unweathered, igneous rock—are being excavated as a preliminary to the actual building of the dam. Crushed, it would make what would normally be considered a good material for concrete; but in the interest of providing the strongest and safest structure obtainable, the Government specified that river gravel deposits should be used for the purpose. Fortunately, these are not only close by but are present in the needed quantity. It is estimated that, after 24 inches of undesirable top material is stripped off, the 100-acre gravel bed will just about produce the 4,500,000 cubic yards of aggregates which will be required. The deposit is owned by the Government and was turned over to the contractors for use.

In their natural state, the aggregates are not pure enough to satisfy the rigid specifications which govern the making and placing of the concrete. It is required that the sand shall consist of "hard, dense, durable, uncoated, non-organic fragments", and that "it must be free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam, mica, or other deleterious substances." The clauses pertaining to the coarser aggregates are equally exacting. In the further interest of securing concrete which will stand through the years without decay or weakness, the specifications provide for grading the raw materials into sand, three sizes of gravel and one of cobbles, and for their segregating so that they may be used in precisely the proportions desired for making concrete for each of the several different purposes. It is also stipulated that the aggregates shall be washed prior to use—this treatment being designed to free them of adhering silt, sediment, organic matter, or other undesirable substances. The concrete, it may be stated here, must have a compressive strength of 2,500 pounds to the square inch where it is deposited in mass quantities and of 3,500 pounds per square inch for thin sections.

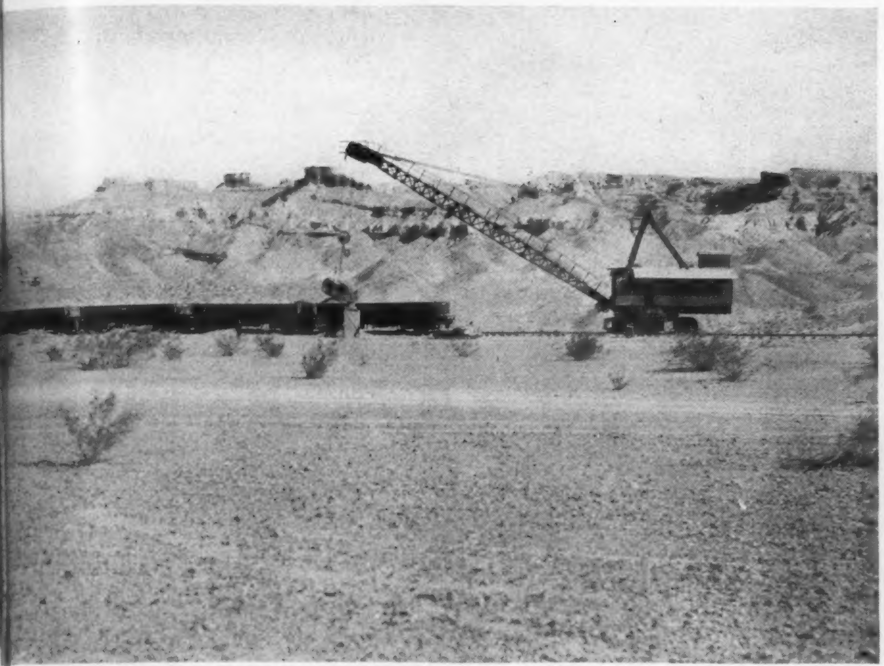
Pressing the button that started the plant on January 9, 1931. Left to Right—H. O. Watts, Southern Sierra Power Company; S. O. Harper, assistant chief engineer Bureau of Reclamation; operator of remote-control station; C. A. Shea, director in charge of construction Six Companies Inc.; F. T. Crowe, general superintendent; T. M. Price, assistant general superintendent in charge of aggregate production.

To prepare the aggregates in the manner designated and in the huge quantities required, Six Companies Inc. have expended some $450,000 in providing what is undoubtedly the largest screening and washing plant ever erected for such a purpose. The framework contains 350 tons of structural steel. This plant is situated in Hemenway Wash on flat ground about two miles from the river. Adjacent to it is Gravel Plant station on the contractors' railroad, a 3-way junction from which one rail line extends seven miles to the Arizona Gravel Deposits, another 4.7 miles to the dam site, and a third seven miles to Lawler, where it meets the Government built section from Boulder City to the Nevada Canyon rim above the dam site.

As set forth in the last article of this series, the gravel pit will be submerged by 1936, and it is accordingly necessary that all the aggregates required to complete the work be removed prior to that time. This circumstance and the fact that small quantities of concrete were needed during the early stages of the work led the contractors to provide facilities for treating the aggregates without delay. The screening and washing plant was started in November, 1931, and was operated for the first time on January 9 of this year. The first concrete was poured on March 5, 1932, to form a foundation for the trash rack at the inlet portal of one of the two diversion tunnels on the Nevada side.

The specifications permit the use of aggregate materials ranging up to 9 inches in section, and it is the function of the gravel plant to crush rocks above that size and to cleanse and segregate into the five prescribed sizes the materials under that maximum limit. As at present arranged, the plant performs these operations upon more than 600 tons of raw aggregates an hour, and it has been laid out so that its capacity can be increased to 1,000 tons an hour. Its essential units are a scalping station and crusher, four classification towers, a sand washer, a sand conveyor

**Tenth of a series of articles on the Colorado River and the building of Hoover Dam.*

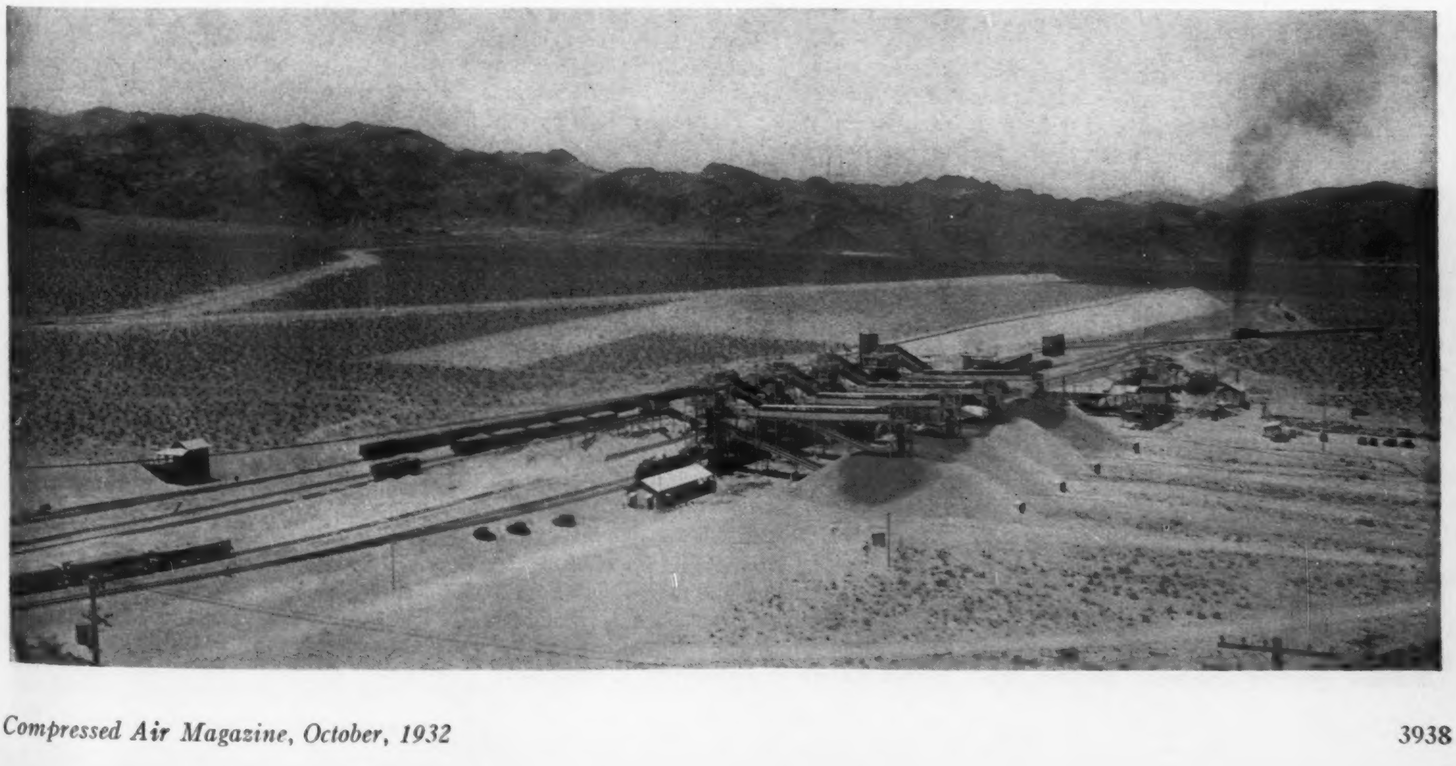


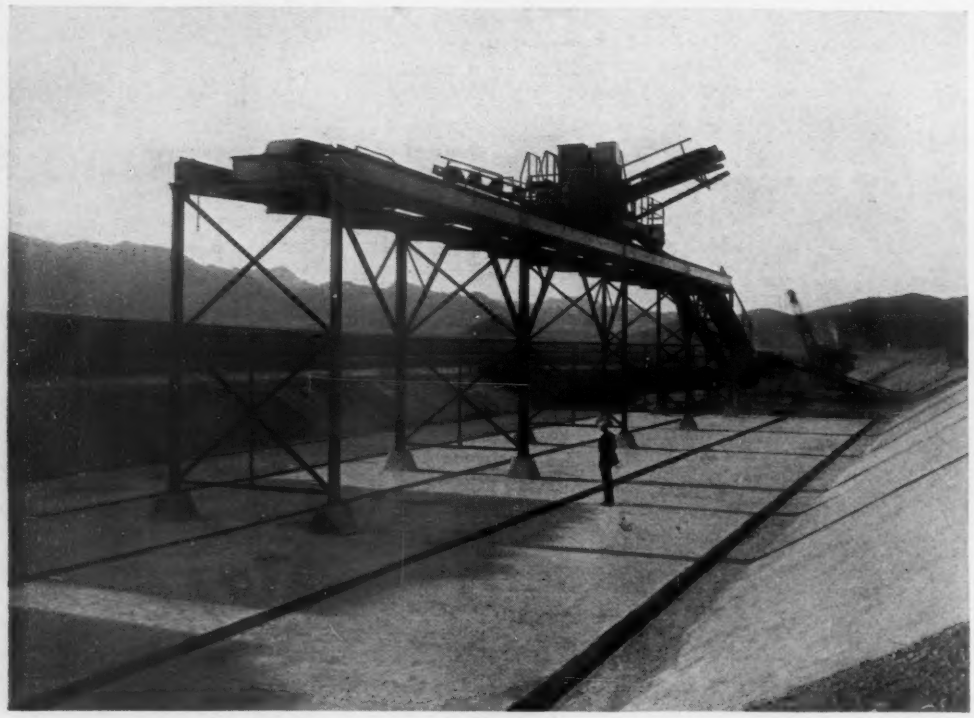
Left—Loading raw aggregates at the Arizona Gravel Deposits.

Dumping a 30-cubic-yard car of aggregates at the screening plant.

Left—Live aggregate storage piles.

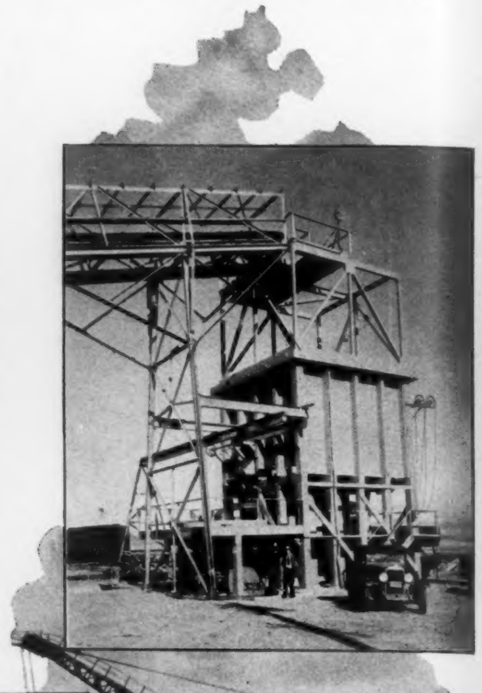
Below—General view of the gravel screening plant that will treat the aggregates for nearly 4,500,000 cubic yards of concrete.





Completed installation for storing sand, showing the concrete base and drain tile insets.

Below—The crushing plant.



The water clarifier during construction.

with automatic tripper, four live storage piles for gravel and cobbles on one side of the towers, and sand storage piles on the opposite side. The materials travel through the plant on a system of interrelated belt conveyors; and, after treatment, are lodged in their respective storage piles to await use. The entire system of handling, from pit to concrete mixing plants, operates with little manual supervision. In fact, fewer than 100 men are engaged in all its departments, including the transportation of the aggregates by railroad.

At the gravel deposits, a Marion Type 125 electrically operated dragline, equipped with a 5-cubic-yard bucket, loads material into Western air-dump cars which are rated at 30 cubic yards capacity but which commonly carry 35. Ten cars make up a train, which is drawn by steam locomotive to the gravel plant. A Bucyrus-43B dragline strips the unusable top portion from the deposit and casts it into adjacent areas from which the gravel has already been excavated. Operations at the pit are carried on in three shifts of eight hours each; and at the time this was written approximately 250 carloads, or 12,250 tons, were being hauled daily.

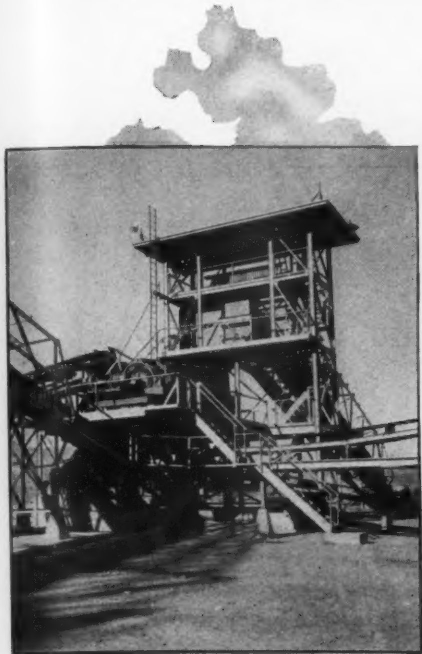
Upon reaching the plant, the cars are dumped either in raw storage piles or directly into depressed bunkers which have a combined capacity of 30 carloads of material. Under the bunkers are vibrating feeders which discharge the raw aggregates on to a 42-inch conveyor belt which runs in a concrete tunnel underneath. The belt transports them to the scalping station, where they are discharged into a cylindrical revolving screen 5 feet in diameter. The scalping screen passes material less than 9 inches through its perforations. Bowlders above that size are dumped on to a conveyor which carries them to an Allis-Chalmers gyratory crusher. Another conveyor returns the product of the crusher to the feed belt running to the scalping station.

The material which passes through the scalping screen is conveyed by a 36-inch belt to the first of the four classification towers, each 60 feet high. There the first of two vibrating screens allows aggregates less than 3 inches in size to pass through. The rejects, made up of cobbles from 3 to 9 inches in size, fall on to a transverse conveyor which transports them to a stock pile. The second screen takes out all sand less than $\frac{1}{4}$ inch in size and passes it to chutes leading to separate treatment machines. The gravel which will not fall through this screen, and which consists of material ranging in size from $\frac{1}{4}$ inch to 3 inches, is carried by a lateral conveyor to the second classification tower. The remainder of the gravel-treating process is a repetition of the procedure at the first tower. In the second tower, material coarser than $1\frac{1}{2}$ inches is removed and conveyed to stock piles. The third tower takes out the $\frac{3}{4}$- to $1\frac{1}{2}$-inch sizes and passes them to stock piles. The final screening takes place in the fourth tower, from which the resulting $\frac{1}{4}$-inch to $\frac{3}{4}$-inch material is transported to stock piles. All screens except the scalping screen are installed in duplicate.

All stock piles are built up above concrete tunnels 11 feet high and 9 feet wide inside. Within these chambers are 30-inch conveyor belts leading to screens in the lower portions of the respective classification towers. Material being loaded out of a stock pile passes on to the belt through gates installed in the tunnel roof and controlled from the inside. It is then run over the screen to make certain that it contains no gravel smaller in size than that designated for that particular pile. This reclassification eliminates dust and debris that have blown into the gravel, as well as fragments that have broken from larger pieces during handling. The gravel that passes over the screen flows to a hopper and a 48-inch perforated conveyor, which loads it into bottom-dump railroad cars for transportation to the concrete mixing plant. While the gravel is in a stock pile it is wetted by a sprinkler system, and while it is moving on the conveyor it is played upon by water jets.

The sand which is laundered has water added to it at the first classification tower and enters a series of Dorr washers and classi-

Below—The scalping tower.



Live storage sand pile a few weeks after the plant began operating.

Rake-type classifier producing sand.

fiers. The first of these has an inclined bottom, and the sand is moved in stages from its lower to its upper end by a series of reciprocating rakes. The process is repeated in a second washer of the same type. As it reaches the plant, the sand usually contains an excess of material of 28 to 48 mesh size. This is segregated in the second washer, where from $\frac{1}{3}$ to $\frac{1}{2}$ of it is discarded. The remainder is recombined with the rest of the sand and passed through a bowl-type classifier for the removal of silt that escaped the previous treatment. It is then dewatered in another rake-type machine, after which it is transported by belt conveyor through a tunnel to the opposite side of the railroad tracks. There it is delivered to an automatic tripper fitted with two stock-pile conveyors, one running in either direction and both perpendicular to the railroad tracks. From these stock piles the sand is loaded as needed into railroad cars by a railroad-type crane equipped with a clam-shell bucket. Tracks have been provided to permit loading from either side of the piles.

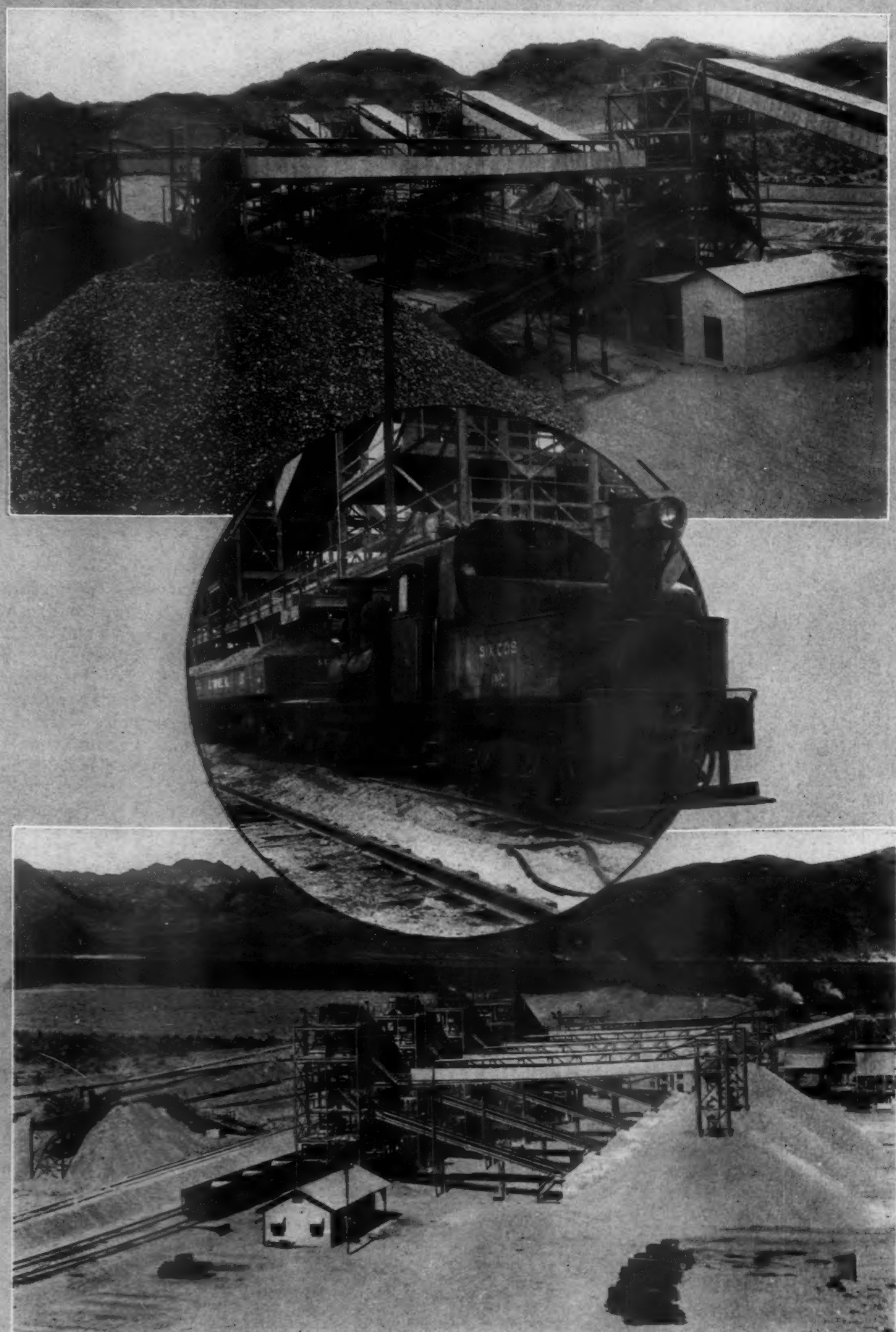
At its present capacity, the plant will supply material for the loading of a 50-ton car every four minutes. Storage space is available for 1,700 tons of cobbles, 1,500 tons each of the three sizes of gravel, and 22,000 tons of sand. By making comparatively slight alterations, speeding up the conveyor belts, and extending the tunnels and conveyors beneath the stock piles, the output can be increased to 1,000 tons an hour.

The entire plant is electrified, and more than 50 induction-type motors are installed. The main supply conveyor and the one serving the first classification tower are driven by 60-hp. motors, and the others by either 10- or 20-hp. units. These belts are all operated at constant speed through speed reducers from the motors. Most of the screens are operated by 5-hp. motors.

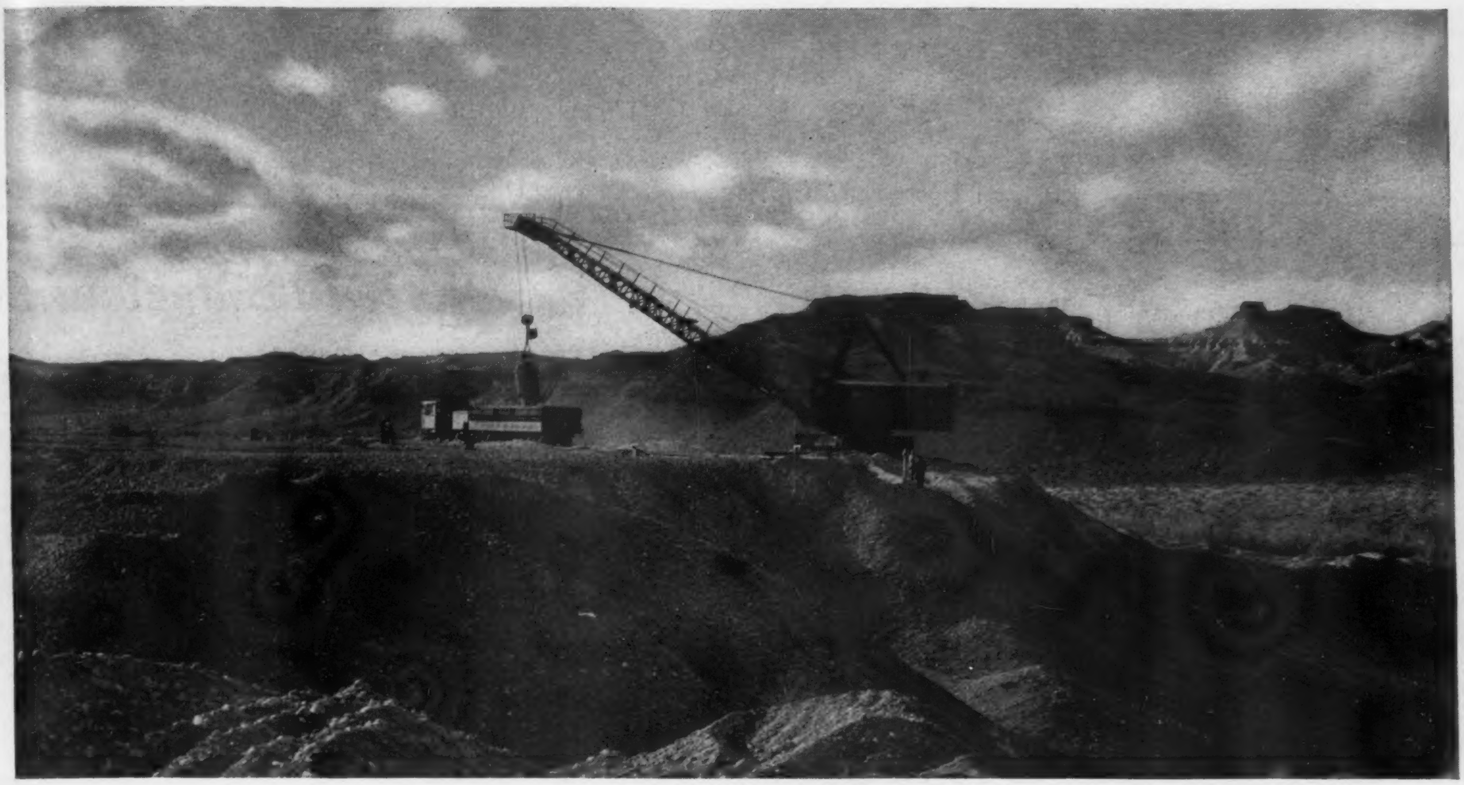
Water is an important agency, and it has to be pumped two miles from the Colorado River and raised approximately 415 feet. It is delivered through a 12-inch steel pipe line in three stages of pumping to an 800,000-gallon circular concrete reservoir, 115 feet in diameter and 15 feet high. This is located 130 feet higher than the gravel plant. The specifications require that the water used for washing the gravel be as low in turbidity as that which will go into the making of the concrete, the allowable maximum being 500 parts silt per 1,000,000. Raw river water contains approximately 36,000 parts silt per 1,000,000, but the suspended matter is of such a character that 98 per cent of it will settle out if the water is permitted to stand as much as three hours. This natural process of clarification is aided in the sedimentation tank by a Dorr traction thickener. The sludge is removed by diaphragm pumps. In connection with the sand washers, previously mentioned, there is a smaller sedimentation tank which receives the silt-laden water from these machines. It is equipped with a clarifier and a sludge pump. After treatment there the water flows to a sump and is then pumped to the large sedimentation tank which is situated on a hill overlooking the plant. The water system is a closed one, and the same supply is used over and over with only small additions from the river from time to time. In fact, of the 3,000 to 4,000 gallons of fresh water used in the plant per minute, approximately 20 per cent is pumped from the Colorado River and the remaining 80 per cent is water returned from the gravel plant.

The entire plant is controlled from a central switching station in the scalping tower. By means of 34 sets of push buttons, each motor and each step in the diversified operations can be individually controlled; and by throwing one master switch the entire plant can be shut down. From this same central station the nine gates or feeders in the bottoms of the supply bunkers are regulated by rheostat control, thereby governing the supply of aggregates reaching the primary conveyor and, incidentally, the output of the plant.

In its raw state, the gravel contains more or less organic matter and considerable silt. Before it enters the plant it has little of the



Top—The gravel plant, with screened gravel and sand in the foreground. Center—Geared-type Shay locomotive switching cars at the gravel plant. Bottom—How the gravel screening plant looks from the crusher bin. The screening towers are at the right.



Plymouth locomotive switching a car at the Arizona Gravel Deposits during the early stage of operations.

appearance of good concrete-making material. After it has been treated, however, it looks altogether different. The several sizes all show up as clean, hard-rock fragments; and one has the feeling that concrete made from them will be as enduring as any structure ever assembled with the aid of human hands. Incidentally, the mineralogist might identify in these aggregates stones from various areas through which the Colorado River and its tributaries pour. It goes without saying that each of the states through which the river flows or which it touches has contributed to that great bar of gravel which was born of the river and which is soon to play an important part in harnessing this temperamental stream and thus turning it into a benefactor of mankind.

The structural-steel frame of the gravel plant was erected by the Pacific Iron & Steel Company of Los Angeles, Calif., and upwards of a dozen firms supplied essential equipment for it. The plant is being operated under the supervision of T. M. Price, who had charge of its design and construction. William Fudge and O. Haugen are his assistants. Government supervision of the production of aggregates is in the hands of O. G. Patch, who reports to Walker R. Young, construction engineer for the Boulder Canyon project.

OUR FRONT COVER

THE picture on this month's cover strikingly illustrates the Hoover Dam gravel-screening plant after nightfall. It was taken by the official photographer on the project. When working at full capacity, this huge plant, which operates well-nigh automatically, will handle 1,000 tons of raw aggregates an hour.

ALUMINUM-ALLOY MINE SKIPS AND CAGES INCREASE HOIST OUTPUT

THERE is a growing tendency here and abroad to increase the net lifting capacity of mine hoists by decreasing the weight of cages and skips. In Canada, for example, several mines are using skips made of an aluminum alloy, a metal which permits a considerable reduction in the weight of the carrier without a sacrifice in strength. Among these mines are the Teck-Hughes and the Wright-Hargreaves, the latter having lately installed three such skips each of 4 tons capacity and weighing about 5,100 pounds, or 3,000 pounds less than the regulation steel skip of like carrying capacity. As a result of this change in materials the hoist can lift a far greater net load than heretofore—in fact, the increase is almost in direct proportion to the saving in weight. The physical characteristics of aluminum closely approach those of steel but its weight is about 65 per cent less, or 174 pounds as against 490 pounds.

The new skips were built for the Wright-Hargreaves mine by E. Long Limited, and are of aluminum alloy with the exception of the dump wheels, pivot shafts, bearings, safety devices, and latches, which remain as heretofore. Another departure in these skips is that the dump wheels, the horn rollers on the dump plates, and the pivot pins for the latches are fitted with roller bearings, which are said to justify the extra cost involved because of the added ease of operation. The Teck-Hughes skip was designed and built in its own shops about a year ago.

In Europe, several collieries have been equipped with cages fabricated of duralumin, which is also an aluminum alloy. In one of the pits, near Munich, Germany, which has a hoist with a total carrying capacity of 7.3 tons, the substitution has led to the following advantageous distribution of weights: Steel cage, 4.1 tons; load of coal per lift, 3.2 tons. Duralumin cage, 2.6 tons; load of coal per lift, 4.7 tons, representing an increase in the hoist's carrying capacity of 50 per cent.

"Just 'supposin' I struck gold drillin' into one of these teeth."

Wresting Precious Stos F

THE ruby is the most valued of all gem stones, and the frequent references to it in the Bible show that it has long been prized. Virtually the entire output comes from Burma, where both old and modern methods of recovery are employed. The Keystone View Company illustration at the left shows natives washing ruby-bearing gravels at Mogok, Upper Burma.

Diamonds have always been associated with romance, and even the methods of mining them are of absorbing interest. At the lower left is a view of the vast pit at Premico, South Africa, as seen from the upper end of the aerial tramway that has carried a king's ransom in sparkling gems to the outside world. Photo by May Mott Smith.

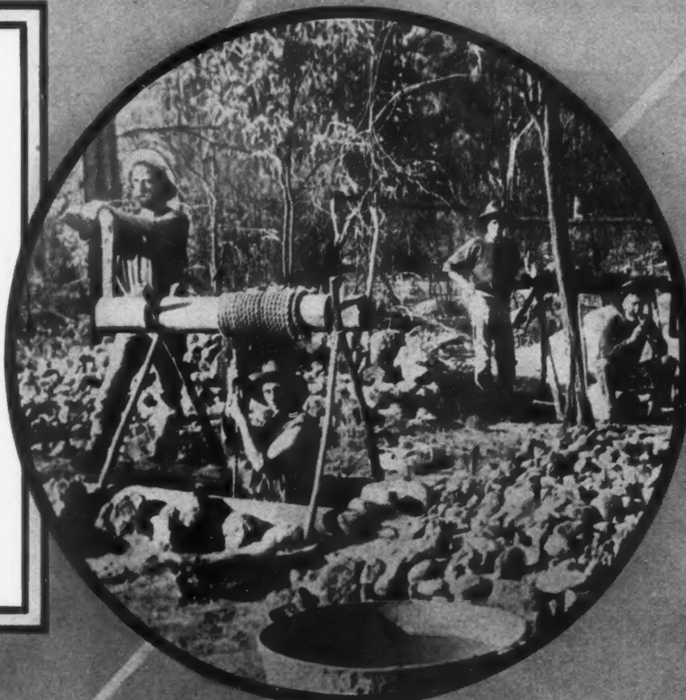
In the circle below is depicted apparatus for washing diamond-bearing gravels in the Belgian Congo, where thousands of natives and modern equipment combine efforts. The Kasai Mine is

Sto s From Nature's Grasp

this section is reputed to be the largest producer of diamonds in Africa. The illustration is from a copyrighted photograph by the Keystone View Company.

In Queensland, New South Wales, seekers of sapphires sometimes sink shafts little larger than the girth of the miners who descend in them in buckets to dig in the drifts far underground. The Underwood & Underwood photograph reproduced at the right shows the windlasses above two of these openings.

Black diamonds are not used as gems, but their hardness renders them valuable for core-drilling purposes. The carbonado or black diamond is found along the Paraguessi River, 300 miles west of Bahia, Brazil. Modern machinery now plays a big part in its recovery. The Keystone photograph at the lower right illustrates the native method of screening and washing the river gravels.



How Fast and How Far Can a Man Drive a Golf Ball?

Jim Reynolds, 1930 national driving champion, and the special apparatus arranged in the General Electric Company laboratories to record the speed of the club head while driving a golf ball. At the right, Gene Sarazen, British and United States 1932 open champion, just after making a tee shot.

Underwood & Underwood Photo.

THE speed of golf balls through the air and of the club head which drives them have been the objects of several recent investigations. Some of these inquiries have been made through pure interest, others to demonstrate the capabilities of new timing devices, and still others for the more utilitarian purpose of aiding golf-equipment manufacturers to develop balls which will travel the maximum distance when correctly hit. At least one of these tests was spectacular in nature, as it took the form of a speed contest between an automobile traveling at a rate of more than 100 miles an hour and a golf ball driven off by Gene Sarazen, 1932 British and American open champion, at the instant the car passed him. In this curious race the golf ball forged ahead at the outset, only to be overtaken and beaten before it fell to the ground because the air resistance slowed its flight.

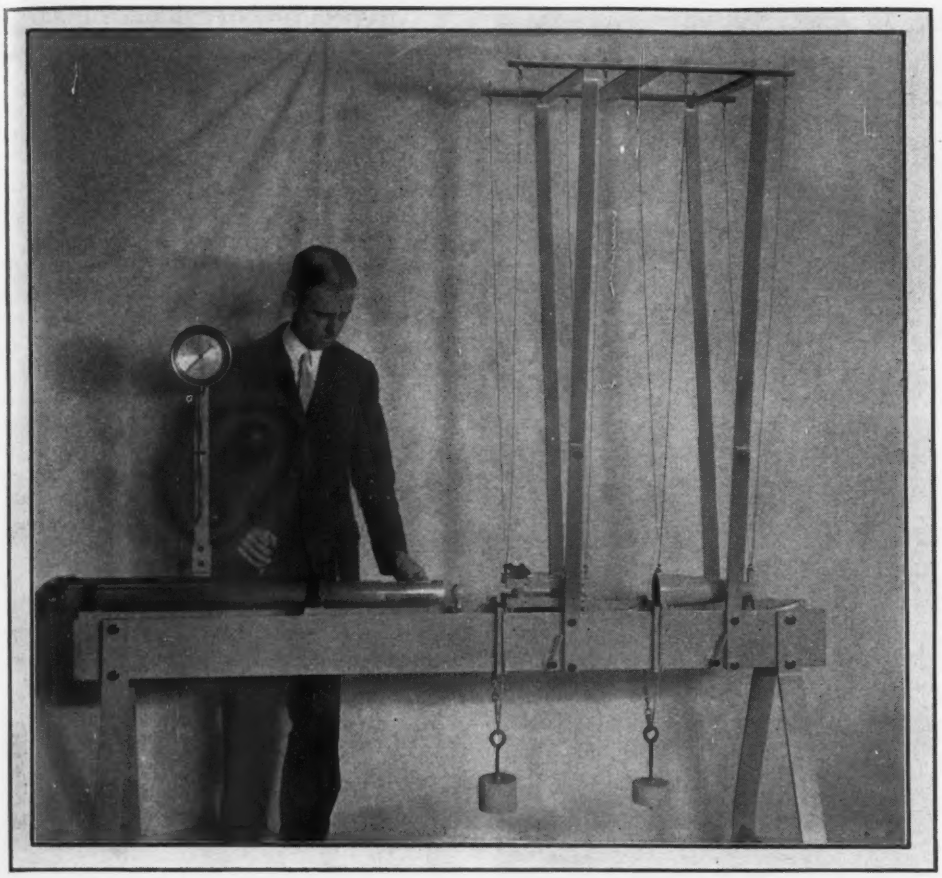
In the research laboratory of General Electric Company at Schenectady, N. Y., the capacity of the phototube or "electric eye" for measuring accurately great speeds was demonstrated by timing the speed of a golf driver when swung by one who is proficient in the art. For this purpose, Jim Reynolds, winner of the national driving contest of two years ago, drove balls off a tee with two photoelectric beams focused on the bottom of the arc of his swing and connected to recording apparatus so as to fix the interval of time required for the club head to move between two closely spaced points. A number of tests showed that the club head was moving at speeds ranging from 70 to 125 miles an hour at the instant of impact with the ball.

At Carnegie Institute of Technology, in Pittsburgh, Prof. J. L. Thomas contrived to set up a mechanical device which would simulate the action of flesh-and-blood golfers and impart to the ball a blow of a force equal to that struck by a master of the game. The machine which he developed for the purpose is shown in an accompanying illustration. It is actuated by compressed air, which medium of power transmission proved adaptable after sling shots, archery tackle, and other equipment had been found unsatisfactory because they did not give the ball the maximum velocity at the very outset of its flight.

Professor Thomas built this golf-ball air gun at the request of the United States Golf Association, and it is being used to test the resiliency and other properties of various types of balls. The apparatus consists of a cylinder containing a piston which is made to move at the desired speed by compressed air of from 60 to 80 pounds pressure. This piston drives against the ball a projectile of the same weight as the head of a golf driver. The ball is placed upon a resting point conforming to a tee, and is driven through a frame suspended as a pendulum into a second ballistic pendulum, which stops it. The first pendulum through which the ball passes serves to stop the projectile, which is of slightly larger diameter than the ball. The ball travels only 2 feet from the point of impact, but that short distance suffices for the registration of essential data by delicate timing mechanisms.

To make certain that the air gun duplicated the performance of a human golfer, and to calibrate it, Professor Thomas asked Bobby Jones, premier golfer of the times, to visit his laboratory. This Jones did, and he drove balls against a ballistic pendulum, mounted in a vertical canvas curtain, which recorded the force put into each shot, the type of pressure applied by the stroke, the length of time the club head remained in contact with the ball, and similar data. The automaton was then adjusted to copy Jones's actions. The investigations which have been carried out with this mechanism show that in producing a drive of 225 yards carry, a pressure of $1\frac{1}{4}$ tons is developed between club head and ball.

In making the tests, the projectile which acts in the place of the club head is caused to move at a speed of 185 feet a second, which is



The ingenious contrivance, built at the Carnegie Institute of Technology, which drives golf balls a la Bobby Jones. The machine uses compressed air for power.

equivalent to 126.12 miles an hour. This has been determined to be the maximum speed of a driver club head when wielded by an expert of the caliber of Mr. Jones. Moving at this rate, the club head imparts to the golf ball an initial velocity of 250 feet a second, equal to 156.8 miles an hour.

The mechanical golfer reveals that the club head remains in contact with the ball through a distance of 1¼ inches when making a drive which carries 250 yards in the air. This is given as an average figure, since the contact distance varies according to the hardness of the ball and is as great as 1¾ inches for the softest balls in use.

The machine demonstrates what all expert golfers know: that it is not the heaviness of the blow that causes the ball to travel great distances. As a matter of fact, the longest drivers in the game—such as Jones, Hagen, and Sarazen—hit the ball with a comparatively light impact but obtain distances through the precision of their technique. By hitting heavy blows that avail him little, the golfing tyro likewise proves that brute strength alone will not accomplish the desired results. The explanation is that this heavy impact reduces the resiliency of the ball to such an extent that it does not start out on its flight at sufficient speed to carry very far.

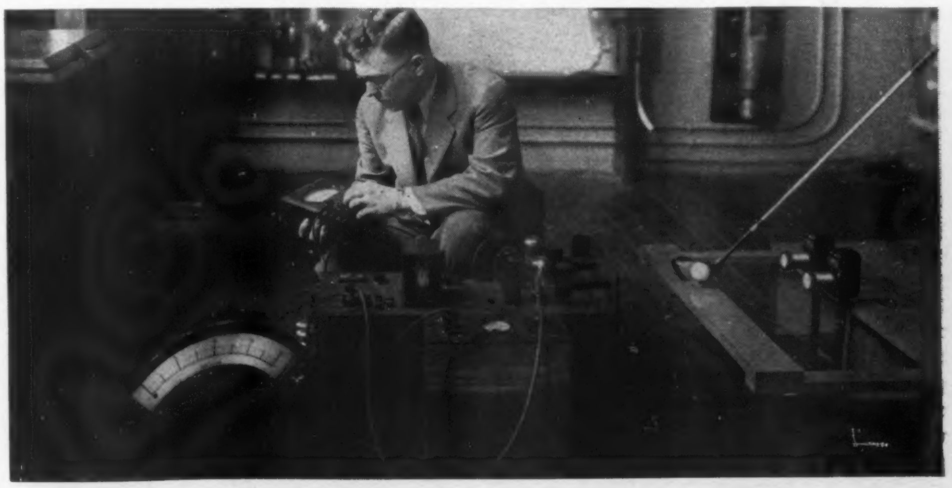
One especially noteworthy point brought out by the machine tests is that if a golf ball is hit a second time in precisely the same spot as before it will carry considerably farther than at the first attempt. This is because its resiliency is increased by the displacement of some of the rubber windings of which the ball is largely composed. On the other hand, the ball, because of diminished resiliency, will not carry as far at the second trial if struck 60 to 90 degrees from the point of the first impact. This reduced resiliency results from the development of a definite amount of friction in the rubber windings as they shift about, which friction absorbs some of the applied force.

Golf balls have been found to be very sensitive to changes in temperature and shifting weather conditions. The average ball is much less resilient in winter than during the warmth of summer. Notwithstanding this fact, the expert golfer can drive a ball equally great distances in winter and summer. This is true because the resistance of the air is at its lowest during cold weather, when the resilience of the ball is also at its minimum. Contrariwise, during warm weather the resilience of the ball is greatest, but air resistance is at its maximum. Under average atmospheric conditions, the machine reveals, the maximum distance that a ball will carry is from 245 to 250 yards. If the ground is dry and hard, the ball may bounce and roll an additional 75 or 100 yards.

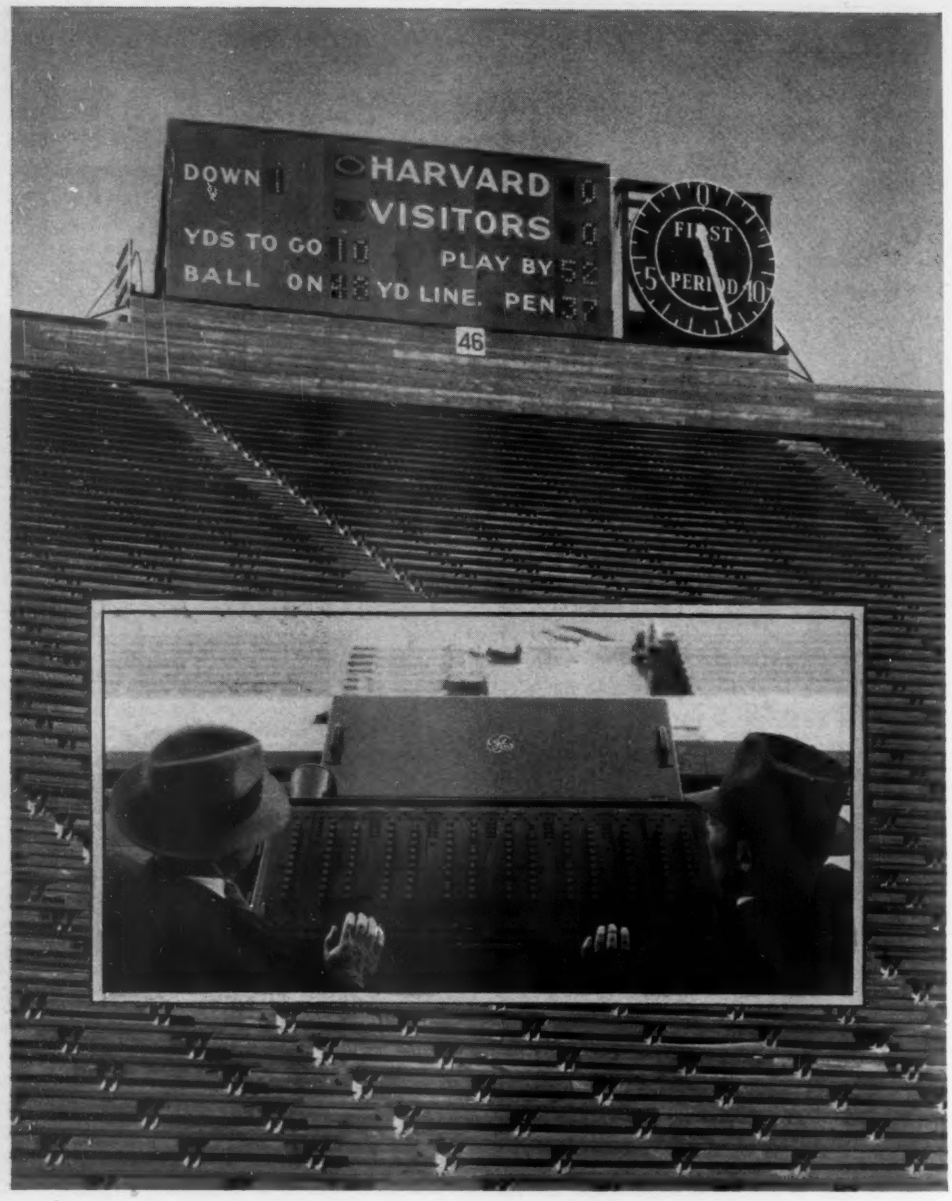
AIR CONDITIONING IN THE HOME

IMPORTANT properties are attributed to a new chemical compound, called "lamisilite", that has been discovered after many months of research in the metallurgical laboratory of the Peoples Gas Light & Coke Company. The work was conducted under the direction of Robert G. Guthrie, chief metallurgist, and Dr. Oscar J. Wilbor, research chemist. It is predicted that the compound will bring air conditioning within the reach of home owners generally and will create a demand for gas at a season when there is usually a drop in the consumption.

According to Mr. Guthrie, lamisilite can be produced at low cost; and because it removes moisture from the air more rapidly and more thoroughly than any other material now available for the purpose comparatively little of it needs to be utilized. This means that small-sized air-conditioning equipment can be built to serve a single room, if desired. Such a unit could be operated at a cost of about .0225 cents an hour. By its use, the warm, moist, and dust-laden air is drawn through a fine spray of water. After it is thus washed and cooled, the air is passed over a bed of lamisilite that delivers it dry and odorless. The saturated lamisilite can be easily dried by means of an automatically controlled gas flame. Another feature of interest in connection with lamisilite is that an ore is used in its production that has heretofore been considered worthless. The name of the ore has not been divulged.



H. W. Lord of the General Electric Company staff is holding the apparatus which times the speed of golf-club heads.



Harvard University's electric scoreboard and the push-button station that controls the signals.

Scoreboard for Gridiron

FOOTBALL enthusiasts are sure to be delighted with what has been done by a group of electrical engineers to throw more light, figuratively speaking, on the game while it is in progress. These men have devised a type of scoreboard which makes it possible for the spectators to follow the movements of the ball and the players and to keep track of the penalties, the score, etc., with ease, thus adding greatly to their enjoyment of the contest. The signals that appear on the board are right up to the minute, in time with the play—there is no waiting, as is usually the case, until the lineman's findings are wig-wagged to the scorers.

The new electric scoreboard was designed and built by the General Electric Company especially for Harvard University. It is 30 feet long and 12 feet high, and mounted on top of the stadium where it is in full view of the spectators. Against its dull-black background flash groups of electric lights, which give ball and numeral signals that are legible even in the glare of bright sunlight from a distance of 300 yards. The brilliance of these lights can be dimmed or amplified, according to the state of the natural light.

The signals are transmitted to the board by means of a push-button station that is so arranged at the 50-yard line that the operator can manipulate its numerous buttons much as he would the keys of a typewriter. From his vantage point at the controls he is thus able, by the aid of quick-acting relays, to give to the thousands of spectators in the vast stadium the complete "inside story" of the game and, what is more, give it to them without any delay.

PATINA ON COPPER PRODUCED SYNTHETICALLY

COPPER has been utilized for centuries in building construction—one of the principal earlier uses being for the domes of cathedrals and monumental structures. The green patina that develops through natural weathering on the exposed surfaces of copper was greatly admired by architects of bygone days; and tradition tells of various unusual methods employed to accelerate its formation. None of these was successful. Now after years of work, John H. Freeman, Jr., and P. H. Kirby have developed a process by means of which copper and certain copper alloys may be given an adherent green surface coloring that is practically identical in composition and appearance with the patina that forms on copper when exposed to the atmosphere for a period of years. The process, says *Metals & Alloys*, must at present be applied to copper shapes before installation. These synthetic patinas are believed to be permanently resistant to weathering. To date, specimens exposed to a severe industrial atmosphere for more than six months, during which time they were wet down by heavy showers four times daily, have shown no change or lack of adherence. Similar specimens exposed to a strictly marine atmosphere for five months, including severe winter weather, have shown no failure or tendency of the patina to break down.

Patina is traditionally referred to as being a basic copper carbonate. In the fall of 1928, samples of copper roofing were removed from the railroad station at Providence, R. I., from Woolsey Hall at Yale University, and from a factory building and a residence at Waterbury, Conn., and their surfaces analyzed. The results were surprising. In each instance the patina was found to be a basic sulphate rather than a basic carbonate. Independent studies made at about the same time revealed that the patina on the copper roofs of some of the oldest structures in England was also basic sulphate.

An extensive study was made of the action of copper in various synthetic atmospheres of known carbon dioxide, oxygen, air and moisture contents under various conditions of concentration, temperature, and pressure. It was found during the course of the experiments that copper exposed to a spray of ammonium-sulphate solution for about 24 hours acquired a dark-green adherent patina. Alternate immersions in the solution resulted similarly; but not so a continuous immersion, indicating that the formation of the patina was intimately associated with an oxidizing action of the atmosphere combined with the ammonium-sulphate attack.

On the basis of these discoveries the commercially practical process was worked out. The color of the synthetic patina is a dark-blue-green. It is relatively permanent in industrial atmospheres; but, on exposure, changes gradually to the lighter natural shade. In marine atmospheres the change is more rapid. The patina may be applied in about 24 hours, as compared with the twelve to fourteen years required by natural weathering.

Baltimore Doubling Her Water Storage

R. G. SKERRETT

Ramps on which trucks were lowered and raised by cables and, above, a section of the dam when nearing completion.

A "Calyx" drill preparing a 36-inch hole for a wire-saw tension post. The partly excavated keyway above was cut with wire saws.

General view upstream from the dam site, and, above, a "Calyx" drill sinking a hole in the western keyway.

Unusual Facilities Employed in Excavating Cut-Off for Prettyboy Dam on Gunpowder River

LIKE many other large cities in the United States, Baltimore has had to meet a growing demand for water for domestic and for industrial uses. This has been the consequence of a multiplying population and the widening limits of the municipality.

The individual citizen of today utilizes more water than did his parents and grandparents; and a modern city is indeed fortunately circumstanced if it be not forced to go farther and farther afield for its water. Baltimore still has ample resources within a relatively moderate distance from its center of population. Baltimore's Bureau of Water Supply is now engaged in a further development on the Gunpowder River that will add very substantially to its reserve of water for distribution during the months of light rainfall. The work in hand will provide for the more intensive use of the watershed that is now the city's main reliance.

The first effort to develop the watershed of the Gunpowder River for the benefit of Baltimore dates back to 1881, when the population of the Monument City was a little more than 332,000. At that time a low dam was built at Loch Raven, and a 7-mile water tunnel was constructed. By 1900 the population of Baltimore had mounted to substantially 509,000, and the water requirements had increased proportionately. It was not long before steps had to be taken to enlarge the impounding basin on the Gunpowder River; and in 1913 the erection of a second and larger Loch Raven Dam was started. Nine years later the crest of the second Loch Raven Dam was raised 52 feet; and at that elevation it now creates a reservoir that has a capacity of about 23,000,000,000 gallons. The tributary watershed has a drainage area of 306 square miles.

The Bureau of Water Supply, realizing that still other resources would have to be available to take care of Baltimore's augmenting population—now numbering more than 805,000 persons—planned some while back to rear another dam on one of the branches of the Gunpowder; and the site chosen was near Parkton, about 25 miles directly north of the city. There it is that Prettyboy Dam is nearing completion. The overflow section of Prettyboy Dam will be 280 feet above the crest of Loch Raven Dam. The new dam will form a basin extending upstream for a distance of 7¼ miles and will be capable of holding 20,000,000,000 gallons. A drainage area of approximately 50 square miles will deliver its run-off to this reservoir. It should be mentioned that the Prettyboy Dam will not draw upon any new source of water for the city, but it will form a storage basin for water which has heretofore gone to waste over the lower dam at Loch Raven when rainfall has been abundant.

The Prettyboy Dam site was primarily selected for its physical rather than its geological advantages. That is to say, the conformation of the valley was desirable and the elevation favorable; but the outcropping rock gave some debatable indications that it might not be sound enough to provide proper anchorage for the projected dam. The rock is a mica schist. Wherever exposed, the formation has been much weathered; and twice during the ages gone it has been shoved by crustal movements and faulted by the stresses then set up. A third difficulty that was foreseen was that the rock would overbreak when blasted. Following the starting of actual construction, additional investigation of the rock at the site was made by drilling large and deep shafts into which consulting geologists could be lowered so as to make a concise drawing showing the location, the drift, and the strike of all faults and large seams encountered in the shafts. This procedure enabled the experts to make what might be termed a full-size inspection of the rock and, at the same time, to take truly representative samples. The following informative particulars have been furnished by the Bureau of Water Supply.

The plans for the Prettyboy Dam called for a cut-off trench 6 feet wide on the upstream side of the structure; and the trench was to extend from 10 to 15 feet below the foundation level of the remainder of the dam. The specifications required that the cut-off trench should be excavated with a channeling machine. No blasting of the sides of the trench was to be permitted, and only light blasting was to be allowed in breaking up the rock between the parallel flanking channel cuts. This procedure would have entailed operating drawbacks; and this was realized before work was actually begun. Because of the necessarily large number of horizontal steps that would have to be made in both the foundation and cut-off trench on both sides of the valley, it became evident that the use of bulky and heavy channeling machines would entail a considerable amount of difficult handling. It was also apparent that the depth of the trench at numerous points, where vertical risers in the steps were to be excavated, would

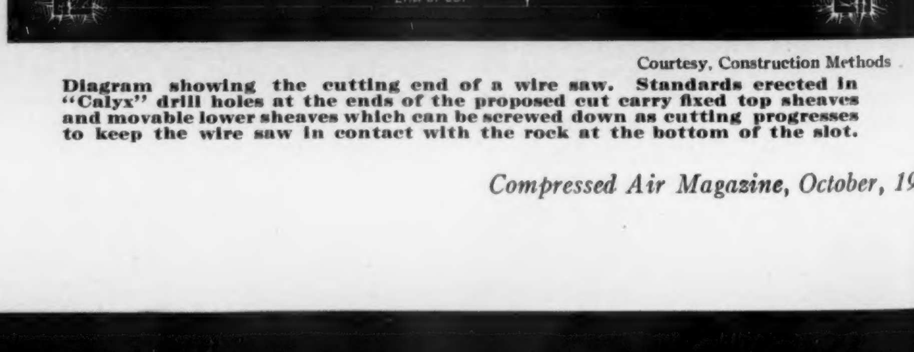
A wire saw, operating between "Calyx" drill holes, cutting one of the stepped sections of the keyway by which the eastern end of the dam has since been anchored to the rocky slope of the valley.

make it necessary either to excavate the trench at the top to a sufficient width for stepping in the sides as the cuts were successively made downward or to cut the channeled slot on a slant so as to give ample width at the bottom for setting up the track and operating the machine in each of the cuts to be made below the top cut. In no other way could excessive width be avoided. The end clearance required by a channeling machine at each vertical step would also prevent from 2 to 3 feet of channeling being done at such points.

Before any channeling was started, the original contractor, the J. A. LaPorte Corporation, consulted the Ingersoll-Rand Company, and, after all the facts in the case were considered, the use of wire saws was recommended. To make reasonably sure that this was practicable, samples of rock from the dam site were sent to Wind Gap, Pa., where the pieces of rock were cut with wire saws in service in the quarry of the Phoenix Slate Company. The outcome of the tests was so satisfactory that the authorities of the City of Baltimore permitted the substitution of wire saws for the channeling machines prescribed in the contract. The J. A. LaPorte Corporation bought, in due season, one "Calyx" drill and four wire saws.

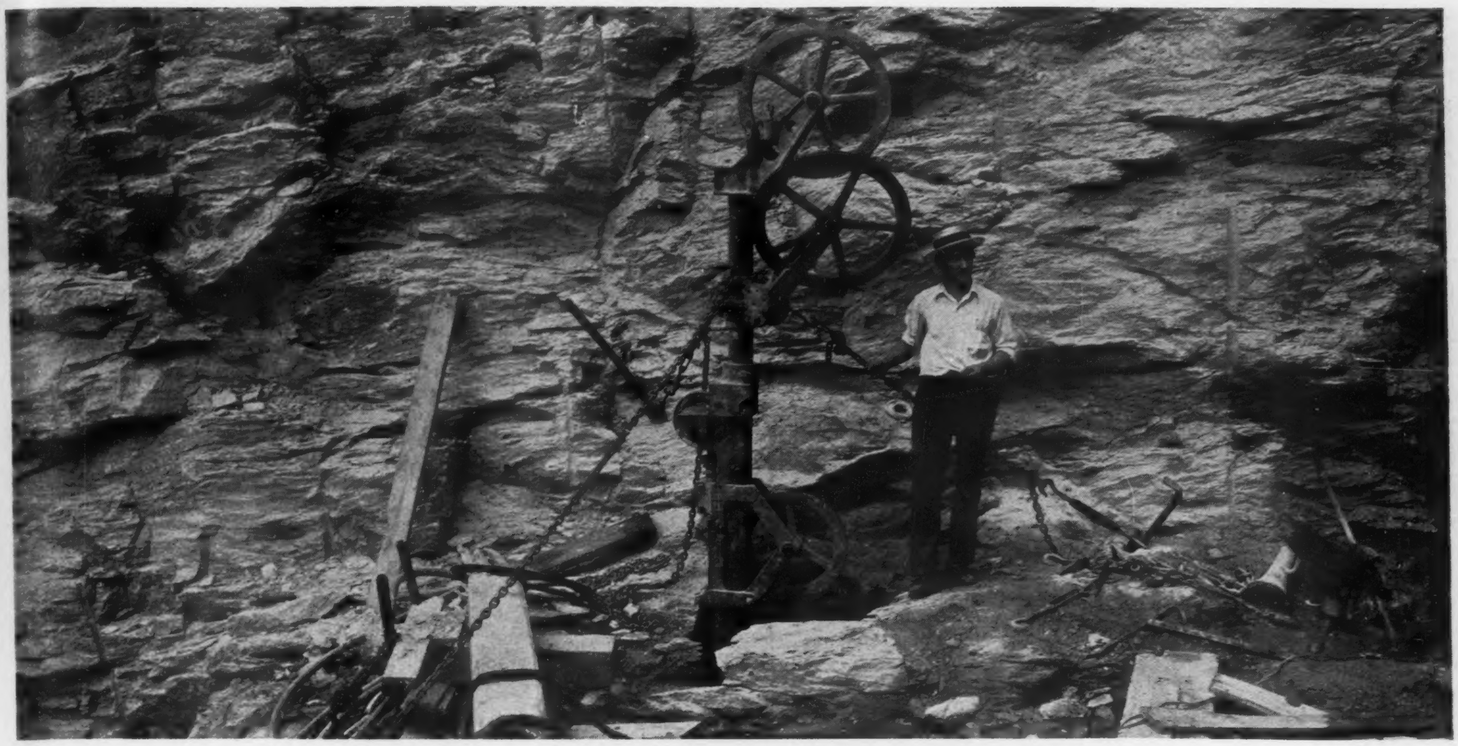
According to Mr. Charles B. Cornell, resident construction engineer for the city, the operation of the saws in the mica schist has been slow, and in a few locations the hardness of the rock has necessitated recourse to line drilling and broaching. In general, however, the saws have produced very satisfactory results and, due to their lightness and to the flexibility of all parts of the rigs, the work has been less costly than previous experience indicated would have been the case had channeling machines been employed. The use of the wire saw involves the following procedure: "Calyx" drill holes, 36 inches in diameter, are drilled to a depth of about 2 feet below the required bottom of the cut-off trench—chilled steel shot being used as an abrasive for the drill. A structural steel standard is then set up in the "Calyx" drill hole at each end of the projected cut. Each of the standards has a top sheave which directs the cutting wire downward to a lower sheave carried by a cast-iron frame that is mounted on the standard. This frame can be moved up or down by a screw shaft extending along the standard.

Cuts are generally started with a sawing wire that is ¼ inch in diameter and made up of three prebent strands of special steel wire manufactured by the American Steel & Wire Company. The wire is passed over the sheaves on the standards and through other conveniently placed sheaves to a motor-driven worm-geared driving jack, and thence to a weighted take-up device set close to the jack at some suitable point on the sides of the valley. With this done, the ends of the wire are spliced together—the prebending of the strands making this a simple operation because the ends of the strands do not have to be tucked. When the reeving is completed, the bottom sheaves on the standards are screwed down so as to bring the wire in contact with the top of the rock at a suitable pressure or tension. Any spaces between the wire and the uneven surfaces of the rock are filled up with sand or loose earth so as to prevent loss of the cutting sand and any swaying of the wire. The driving jack is then started and quartz seashore sand is fed into the entrance end of the cut by means of a small jet of water. The wire and water, traveling continuously in one direction, carries the sand along with it; and this abrasive cuts a slot the width of the wire. As the cut progresses downward, the lower sheaves are screwed sufficiently lower, from time to time, to maintain the cutting pressure of the wire.



Courtesy, Construction Methods

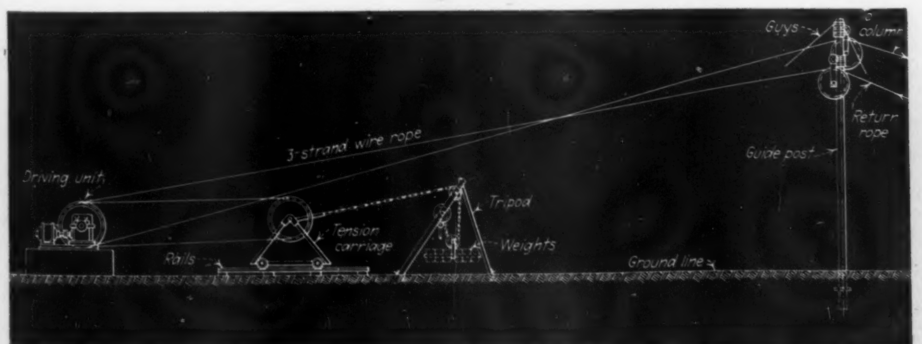
Diagram showing the cutting end of a wire saw. Standards erected in "Calyx" drill holes at the ends of the proposed cut carry fixed top sheaves and movable lower sheaves which can be screwed down as cutting progresses to keep the wire saw in contact with the rock at the bottom of the slot.



Making ready to reeve a wire saw over the guide wheels. The lowest wheel will be screwed downward to maintain pressure on the wire saw as it cuts deeper and deeper into the rock.

Cuts ranging from 30 to 90 feet in length have been thus made at a rate of from 6 to 20 inches during a 24-hour day—the depth of the cut depending upon the hardness of the rock. A saw wire, on a cut 30 feet in length, will generally cut from 3 to 8 feet in depth before breaking—the hardness of the rock being the controlling factor. As soon as the wire wears down to the breaking point, a new and smaller wire is run over the sheaves and the cut continued until the depth is reached—say 6 to 8 feet—that warrants the starting of mucking operations. The trench is mucked to the depth of the sawed cuts; and new saw cuts are begun with the largest size of wire.

The present plans will probably require the removal of approximately 3,400 cubic yards of rock from the cut-off trench, most of which will be sawed on both sides to the full depth. For the setting up of the saw standards it will be necessary, before the work is finished, to drill all told about 50 "Calyx" drill holes varying in depth from 12 to 18 feet—depending upon the depth of the cut-off trench at different points. Of these holes, two have been used as test holes—one of them being drilled to a depth of 57 feet. Two additional holes will be used both for the setting of saw standards and for the excavating of a vertical cut-off keyway in one of the vertical rock faces encountered in the excavation. These holes, when completed, will extend to a depth of 52 feet or more. Besides the foregoing, two other test holes were drilled which will not be used in connection with the cut-off trench. These particular holes were carried to an approximate depth of 30 feet. All "Calyx" drill holes have been and will be 36 inches in diameter; and the present application of this form of drill is further evidence of its adaptability and its steadily widening field of usefulness. The cost of making such holes would be well-nigh prohibitive if conventional shaft-sinking methods were employed.

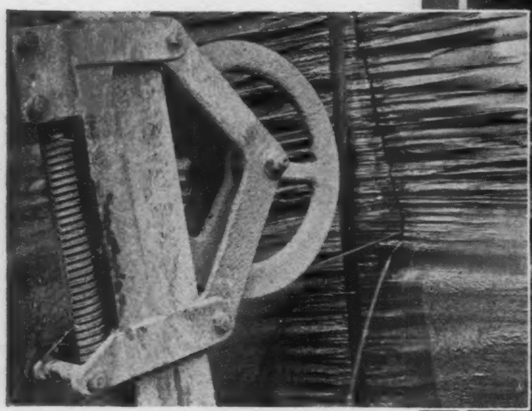


Courtesy, Construction Methods

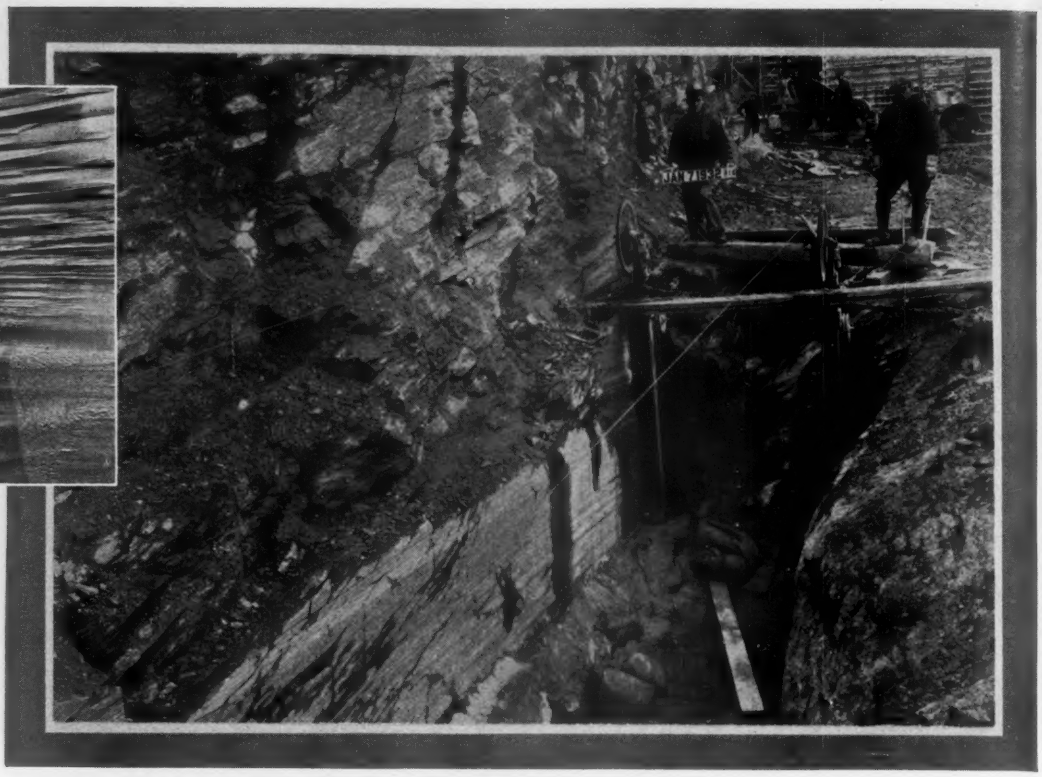
Diagram showing the driving end of a wire saw. Continuous wire rope is wound on the power pulley of the driving unit, and one loop is reeved over the sheave of a weighted carriage which maintains uniform tension on the rope. Guide sheaves on the steel post carry the rope to and from the cutting end of the saw.

Work on the Prettyboy Dam was started on November 17, 1930; and the project in its entirety is scheduled to be completed by the end of the present year. Since the undertaking was begun, the design of the dam has been somewhat altered. The total height of the structure, exclusive of bridge balustrade and gatehouse, is 188½ feet. The maximum base width of the highest part of the dam is 122 feet; and the bridge width on top of the dam is 31 feet 10 inches. The bridge will have a 20-foot roadway and two sidewalks each 5 feet 11 inches wide. The bridge will have a length of 692½ feet, and the spillway beneath the bridge will have a total length of 274 feet—that is, the water will flow beneath four arches each of which will have a clear span of 68 feet 6 inches. The total length of the concrete structure, from side to side of the valley, will be 855 feet. The dam will raise the water above the normal stream surface to a height of 133 feet. The maximum length of apron will be 93 feet; and the total upstream and downstream extent of the dam will be 244 feet. The gatehouse section is in the middle of the overflow portion of the structure.

The overflow part of the dam has an ogee gravity section, and the flanking abutments have a nonoverflow gravity section. The dam rests on solid rock at all points; and its ends have been extended into the rock on each side of the valley. At the western end of the structure the upper part of the rock formation has been weathered to a considerable depth and the sound rock there does not rise as high as it does on the eastern side of the valley. A short core-wall section will be constructed to form a water stock, and this will penetrate the weathered rock. The core wall is to be flanked by earth embankment.



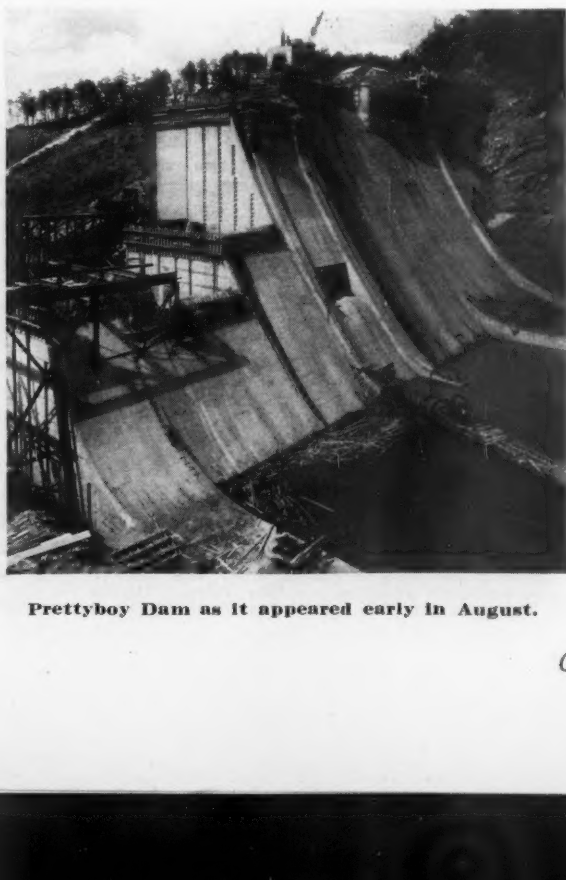
The lower end of a tension post with screw shaft for lowering the tension pulley. Note the wire saw and stream of water and sand issuing from the bottom of the slot. Right—Two wire saws simultaneously slotting both sides of a keyway for anchoring the dam.



To make certain that the rock underlying the dam will be proof against seepage, several lines of grout holes have been drilled in the upstream third of the base to an average depth of 20 feet, and grout is being forced into the holes under suitable pressure. The excavating of all classes of material has necessitated the removal of 400,000 cubic yards; and a large percentage of this has been rock.

When the basin is filled to overflowing, which would normally be reached in the course of twelve months, the water will flow over the crest into a stilling pool in which it will have a depth of 8 feet. The floor of the pool is being constructed of concrete 6 feet in thickness so as to guard against the erosive action of the descending water. The normal discharge of the water from the basin will be controlled from the gatehouse. That structure will be in two sections, and each will contain its own set of regulating machinery. The outlet works will consist of two independent cast-iron pipe lines, 54 inches in diameter. Each line will have twelve screens, four 3x5-foot rectangular sluice gates, one 36-inch-diameter cone valve, and one balanced free-discharge needle valve also 36 inches in diameter. The water will be drawn from a well on the upstream side of the gatehouse. The sluice gates will be arranged as follows: Two at the lowest level, one at the intermediate level, and one at the highest level. The center of the lowest gates is 34½ feet above the original stream level; and this will leave considerable space below for the accumulation of silt.

The contractor has placed his concrete plant on the east slope of the valley at a convenient point above the dam to facilitate the distribution of the concrete; and sand, rock, and cement are placed in seven capacious compartments from which each ingredient, in measured amounts, can be conveyed to the mixers which are located 30 feet below the bottoms of the great storage bins. The aggregate materials are discharged into volumetric or weigh batchers that feed on to a belt conveyor that carries the material to a hopper having a 2-way spout permitting the aggregate to reach one or the other of the mixers. From the mixer, the concrete is discharged directly into 2-yard hopper cars that travel across the valley on a timber trestle built a short distance upstream from the structure and at an elevation of approximately half the height of the dam.



Prettyboy Dam as it appeared early in August.

Concrete is distributed from the trestle in 1- or 2-cubic-yard buckets handled by either a steam-driven traveling whirley mounted on the completed part of the crest or by a traveling steam-driven stiff-leg derrick mounted on a structural-steel trestle. An additional stationary stiff-leg derrick will be erected to handle the concrete placed to the west of the area covered by the traveling stiff-leg.

The J. A. LaPorte Corporation—Joseph A. LaPorte president, has the contract for constructing the dam, but the work is now being administered by a committee representing the parties furnishing the larger items of materials, equipment, etc. On the work this committee acts through George A. Bacot, of the Arundel Corporation, as superintendent.

The dam is scheduled to be finished this fall; and, with its appurtenant features, will entail an outlay of approximately $2,400,000. Purchased real estate, clearing land, and the building of bridges, culverts, roads, etc., will raise the ultimate cost to $3,500,000. When completed, the dam will enable Baltimore to face a protracted dry spell without fear of a water shortage. We wish to acknowledge our indebtedness to Mr. Leon Small, Water Engineer of the Department of Public Works, for much of the data contained in this article.

It may surprise some of us to learn that there are at least twelve metals that outweigh lead, and that ten of them are more precious than gold. Osmium is the heaviest-known metal and weighs almost twice as much as lead.

Suggested Improvements in Submarine Drilling Methods

CHARLES C. HANSEN

Drill boat "Teredo No. 2" at work in the fore bay of Miraflores locks in the Panama Canal.

SUBMARINE drilling plants, as gradually developed on the Great Lakes, consist of steel boats from 100 feet to 160 feet long, 30 feet to 42 feet wide, and 5 feet to 10 feet in depth of hull. On one side are mounted from three to five piston drills in movable towers so that each drill can put down a row of from four to six holes, the combined number of drills producing a line of holes depending on the length of available travel.

The 5½-inch bore by 8-inch stroke or 6½-inch bore by 9-inch stroke steam piston drills (as described in *Compressed Air Magazine* of October and November, 1931, and *Engineering News-Record* of November 12, 1931,) are guided in the drill towers or derricks on slab-backs of sufficient weight to hold the drills steady when drilling, which requires a weight of from 4,500 pounds to 7,000 pounds when handled by wire rope and a corresponding weight when the control is by hydraulic cylinder. The derricks are usually moved along on a wide-gauge track on one side of the boat by a double-acting hydraulic cylinder, with each piston rod connected to a chain passing over sheaves so that any of the towers can be attached to this chain and moved in either direction. A hoist on the derrick floor will lift and feed each drill and handle the sand pipe. All the operating levers and valves are more or less conveniently located for operating the drills. In each derrick are suspended a loading stick on a 3-cut manila tackle for placing the dynamite in the hole, a wash pipe for cleaning and washing holes during drilling, and tackle and lines for handling steel, etc.

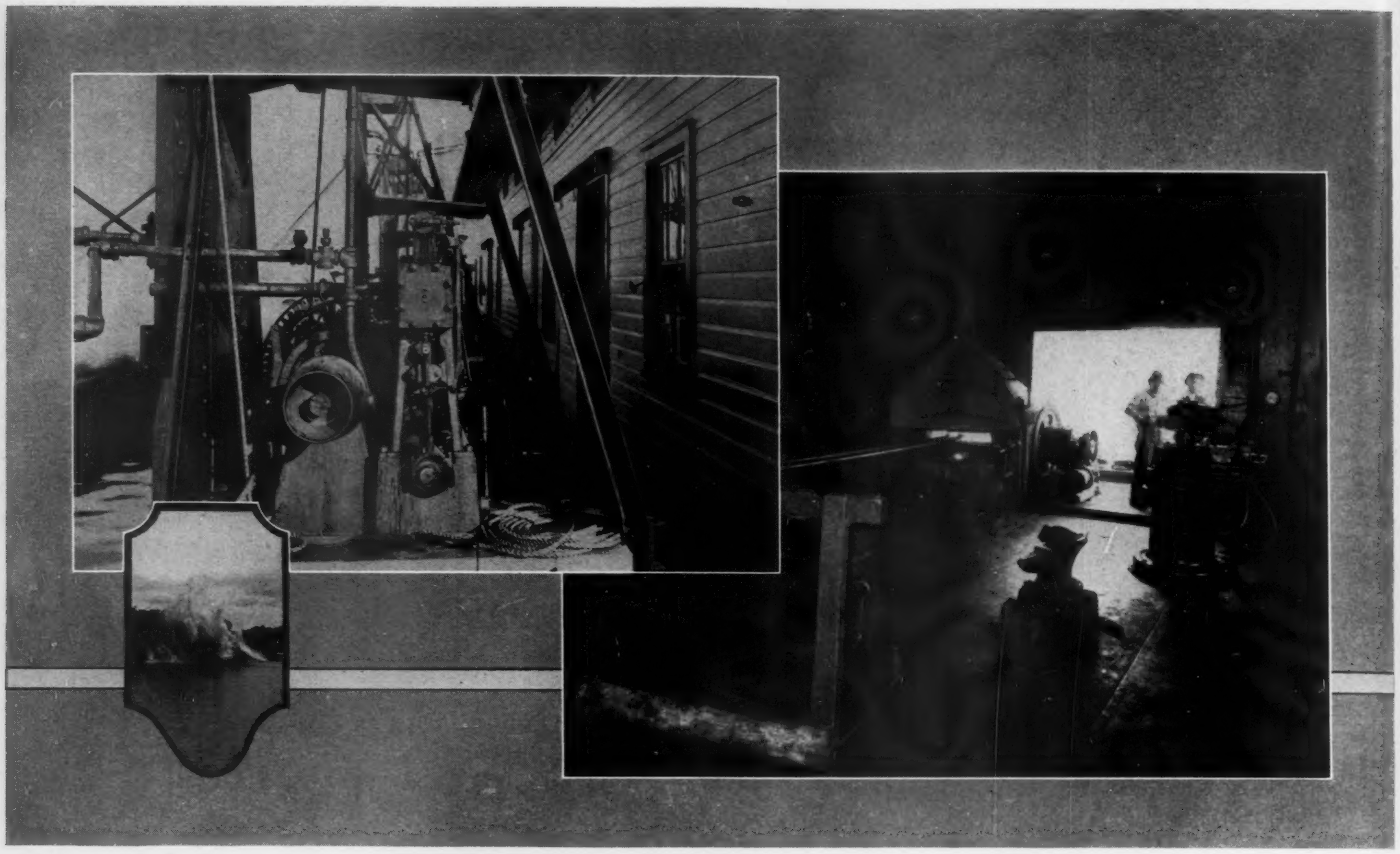
The power plant is usually a marine-type boiler, and to-day, on account of weight and handling, is generally oil fired because the oil can be stored below deck and pumped from the oil boat. But some drill boats will be found with coal-fired boilers and coal bins on deck that take up considerable space. This is the old construction that was common before oil was generally introduced.

For handling, each boat is equipped with hoists and spring lines—from four to six, depending on the water—and with four anchor spuds, one in each corner of the hull, on which a portion of the weight of the boat can be lifted, "pinned up", to keep it stationary during the drilling period. In addition, it is equipped with pumps for the hydraulics, boiler feed, and bilge and fire protection, and usually with an electric-light plant, as these boats must at times operate continuously for 24 hours.

In drilling holes underwater, the different operations constituting one "hole-cycle" can be divided up as follows:

1—Lowering sand pipe to rock.
2—Washing out mud or material inside of sand pipe.
3—Lowering drill until steel strikes rock.
4—Drilling hole in rock to the required depth.
5—Lifting drill and steel.
6—Washing out hole before loading.
7—Loading hole with explosive.
8—Lifting sand pipe and securing exploder wire.
9—Moving drill tower to next hole.
10—Changing drill steel.

Each of these ten operations consumes a measurable time. Drilling a hole and loading it with explosive are the productive operations in blasting rock. The time it takes to drill a hole depends on the hardness and on other characteristics of the rock, and is therefore variable. The nine other operations are constant. As the total time consumed, or 100 per cent, is one hole-cycle, it is evident that any decrease in drilling time will result only in a small decrease in the hole-cycle time. In average hard limestone the time spent in "drilling hole in rock to the required depth" is about 40 per cent of the hole-cycle time. Suppose in a softer rock it takes only half the time to drill the hole—the time for the other operations remaining the same, then the drilling time will be 25 per cent of the hole-cycle time. It is necessary to speed up the nine other operations to increase the reciprocating time of the drills. An important unit in the operation of the plant is the blacksmith shop for sharpening and for making the drill bits. This work usually increases with the hardness and abrasive condition of the rock; and form and



Left—Lower end of one of the drill derricks on a United States Engineers boat in the Mississippi, showing hoist used to raise and lower the drill. Right—Blacksmith shop on a boat equipped with X-80 submarine drills.

accuracy in the dimensions of the drill bits have a distinct influence on the amount of drilling done.

Piston drills are also made with an external box which feeds water under pressure through a hollow drill steel so that the material in the sand pipe and the cuttings in the hole can be more completely expelled. This will increase the drilling speed and also eliminate the operation of washing out the sand pipe and the hole before loading—to this extent decreasing the unproductive time. This is unquestionably a step in the right direction and will reduce the cost of submarine drilling, especially in softer rock formations.

Aside from the water feed, the speed of the different operations and the proper and convenient location of all operating levers will have a controlling influence on the time. Give the operator a convenient seat from which to work. As he has to use his feet as well as his hands, it should be arranged as carefully as the driver's seat in an automobile.

For handling the loading stick a small hoist is desirable, as it will reduce the time and the labor required with the 3-cut tackle most frequently used. A small hoist will pay for handling the drill steel; and a traveling crane, or derricks, on top of the deck house might be employed to make this a mechanically controlled operation throughout. One more troublesome operation is the clamping of the steel in the chuck. When steel is changed, the helper with a heavy wrench usually climbs the derrick, and he has to hang in an insecure position while loosening two large nuts or until the steel comes loose. If he descends the derrick to help handle the old steel he will have to climb back again to tighten the nuts in the chuck on the new steel. Some careful planning is necessary to eliminate time lost in this operation, especially if steels have to be changed for each hole. But so far very little progress has been made to cut down this time and to make this operation safer.

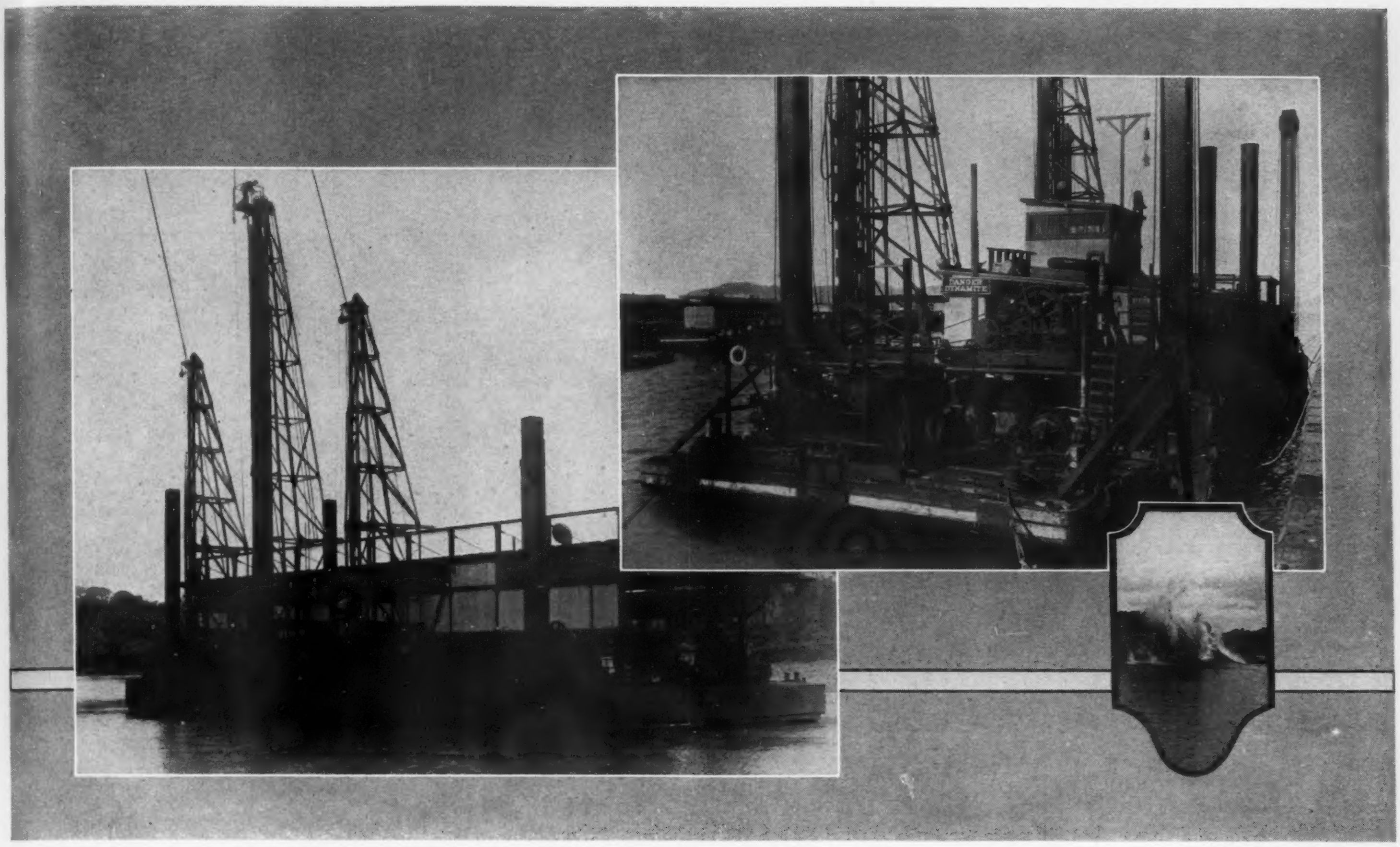
It has been found that a small air pipe welded to the sand pipe and entering the same near the lower end will lift any overburden that may get into the latter due to an imperfect seal between the sand pipe and the rock. If not lifted, this material will sink down in the drilled hole, reduce the drilling speed, and partly fill the hole before it can be loaded with dynamite—to this extent preventing the explosive charge from being placed as low as possible. As there is usually a measurable time between the lifting of the drill and steel and the placing of the dynamite charge in the hole, any material that settles to the bottom of the hole will raise the effective explosive point proportionately. The small air lift will prevent or lessen this loss.

Each of the several drill towers is moved along the deck on rails a predetermined distance to drill its designed number of holes. This operation of shifting the drill tower from hole to hole is also unproductive time. The most popular and the safest means for doing this has been a double-acting hydraulic cylinder pulling a chain guided over sheaves to about the line of tower gravity between the tracks under the drill tower. Each tower can be attached to this chain by a hook or clamp and moved in the desired direction. As the towers usually slide on the rails, and as the starting load from rest is much more than the accelerated load, the hydraulic offers most safety, inasmuch as the speed is induced by the water entering the cylinder and can be controlled or regulated. The length of travel, and the centers on which the holes are spaced, are usually painted on the house wall or on the deck. The hydraulic, however, is susceptible of improvement. It is suggested that the cylinder travel be made slightly longer than twice the travel of the tower and that the cylinder be so arranged that, when used on one drill tower, the piston will automatically return to the central position and therefore be ready for shifting the next tower in either direction.

When the holes are loaded and ready to be exploded the boat must be moved a safe distance, as it is dangerous, even in very deep water, to fire a row of sixteen holes so near the hull. The four anchor spuds are lifted, and the boat is maneuvered by the spring lines. This work will have to be included in the hole-cycle. Therefore, we have the following additional operations to consider:

11—Waiting for last drill to finish.
12—Lifting four anchor spuds.
13—Moving boat by spring lines.
14—Exploding charges.
15—Moving boat back to next line of holes.
16—Dropping anchor spuds and pinning up.

On the average drill boat, with four drills working on one side, each drill will finish four



Left—Government drill boat "Terrier No. 2" engaged in testing a hammer-type drill and tower. Right—A Siems-Helmers, Inc., drill boat at work in San Francisco Harbor, showing the spud and anchor engines.

holes. Although the four drills are exactly the same, one of them will always take longer than the others to do the work. This may be due variously to pockets or cracks in the rock, to a difficult stratum, or to trouble in starting a hole. As the boat cannot be moved before all sixteen holes are completed and loaded, the time it takes that particular drill to complete its allotted number of holes is the determining time. In the meanwhile, the other drills and their crews are idle. The problem of eliminating or reducing this lost time has had considerable study. It is clear that the greater the number of drills on a boat the larger this time and labor loss is liable to be. By cutting down the number of drills to one, this loss would of course disappear. But in that case all the crew's time on the boat would have to be charged against the one drill. To reduce this loss to a minimum, the two end drills should, perhaps, start drilling on the end holes in the line. In that way it might be possible for one of the other drills to help out by relieving the drill in difficulty of one or more holes.

The four anchor spuds are heavy timbers, 2 to 3 feet square, that can travel up and down in housings on the hull. Each is arranged to be lifted and also to support some of the weight of the hull. The most common means employed for this purpose is a rack bolted to the spud and engaging a pinion on the spud housing that is geared to a reversible steam engine. The thrust of the pinion against the spud is considerable, and if this thrust is not taken up by rollers the friction will absorb a large portion of the power. Another way of doing this is by the use of a wire rope laid over sheaves—one in the lower part of the spud and the other on top—and passing on to the drums of a hoist. The end of each spud is protected with a cast-steel shoe. To move the boat, heavy kedge anchors, secured to the spring lines, are planted in the best locations, from two to three at each end of the craft, depending upon the water. The lines lead to hoists, and are wound off or on the drums, as required.

The actual exploding of the several charges does not take long, as the different exploder wires are connected to a 2-wire cable so that it is necessary only to put each end in contact with an electric circuit or blasting machine. The holes are sometimes handled in other ways. Instead of one line of holes, two, three, or even more may be exploded simultaneously. Then the time consumed in exploding the charges is divided by the number of lines set off. Occasionally each hole is exploded as drilled. In that case item No. 14 is charged against the hole-cycle. The operations involved in the case of the last two items, Nos. 15 and 16, are virtually the same as those that come under Nos. 13 and 12, except that it takes greater care to get the boat back into proper drilling position so that the next line of holes will be correctly spaced.

From the foregoing it is apparent that a drill-boat plant, to drill and blast rows of holes underwater, must be equipped for a lot of different operations. It requires a well-trained crew to do the manifold unproductive operations quickly so that as little time as possible is lost in getting back to drilling. The hull and machinery represent a considerable investment; and in some localities the working time in a year may be less than 200 days. Navigation regulations also dictate terms affecting the handling of the boat as well as the crew, and these have to be lived up to. It can, therefore, be seen that the drilling of subaqueous rock requires very careful study if the cost is to be kept down to a reasonable figure. The boat's crew is usually made up of a captain, an engineer, a fireman, and a powderman; and each drill requires a drill runner and a helper. In addition, there is a blacksmith and a helper for conditioning the steel, and their wages are divided up proportionately among the drills.

In analyzing the different performances of drill boats on contracts, it is almost impossible to draw definite conclusions. Each piece of work is different, and must be handled accordingly. It would seem that the more drills there are on a boat the more economical should be its operation. But we find that the time lost in waiting for the last drill to finish, as explained previously, increases with the number of drills. Supervision of the different operations on the part of the captain also becomes more difficult; and the tendency now is to go back to the use of from two to four drills in the belief that it is the most economical practice. Perhaps it may be that a medium between these two extremes, a 3-drill plant, will show up most satisfactorily.

Proper supervision of the drill crew is very important. The captain should also be an expert driller so that he can train his crew and

A United States Government drill boat, on the Mississippi River, showing the anchor spuds and the steam engines that operate them.

operate his plant to the best possible advantage. Drilling underwater is at the best difficult. All that the drill runner has to guide him, to indicate what is happening in the hole, are the stroke of the steel and the rotation; and each drill has to be handled according to what, in his judgment, is taking place in the hole.

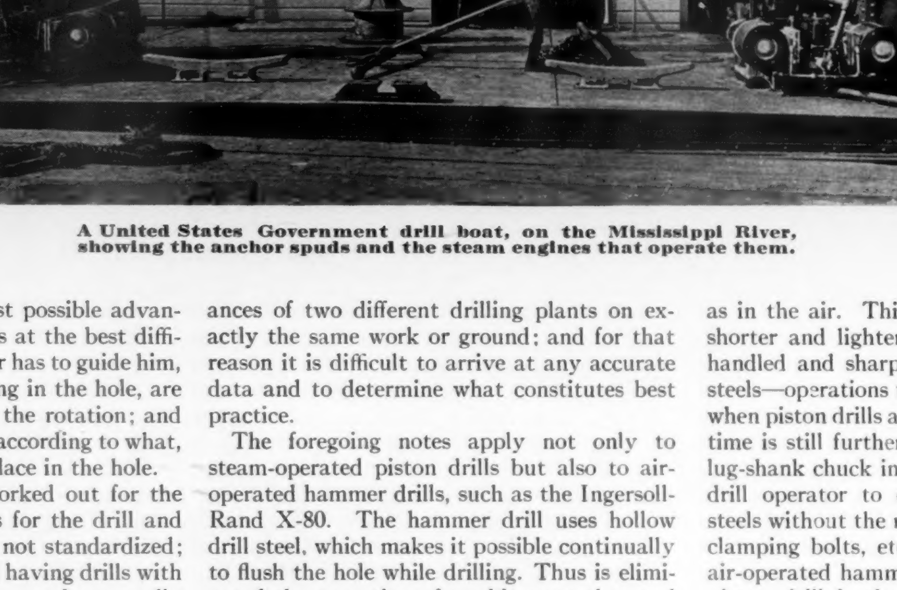
No standard has been worked out for the different parts. The guides for the drill and slab-back, for example, are not standardized; and plants can still be found having drills with hydraulic feed. This, however, is generally considered to be too slow, and is exposed to freezing in cold weather—to this extent shortening the working season possible with the hoist and rope feed that is now generally employed. The indications are that hydraulic feed will finally disappear.

The same lack of standard prevails as to the machinery on the different submarine drilling plants: on each may be found different equipment. A drill plant may have to work on many varieties of rock from the hardest granite to the softest shale—the latter just hard enough so that it cannot be dredged without shooting. A drill boat is expected to cover this range without much modification. Seldom is an opportunity offered to compare the performances of two different drilling plants on exactly the same work or ground; and for that reason it is difficult to arrive at any accurate data and to determine what constitutes best practice.

The foregoing notes apply not only to steam-operated piston drills but also to air-operated hammer drills, such as the Ingersoll-Rand X-80. The hammer drill uses hollow drill steel, which makes it possible continually to flush the hole while drilling. Thus is eliminated the operation of washing out the sand pipe and the hole before loading—a step that is necessary with most piston drills.

The X-80 drill can work underwater as well as in the air. This permits the use of much shorter and lighter drill steels which can be handled and sharpened faster than can long steels—operations that take considerable time when piston drills are employed. The handling time is still further reduced by reason of the lug-shank chuck in the X-80 that enables the drill operator to engage or to release drill steels without the need of manipulating chuck clamping bolts, etc. Another advantage the air-operated hammer drill has over the steam piston drill is that it does not have to get rid of condensate in the pipe lines, nor does it have to warm up as the steam drill has to even after a short shutdown.

It is apparent from the foregoing that there is need of more careful engineering in designing new plants; of the use of hollow drill steel with plenty of water for washing the holes free of cuttings; of centralized control for the drills, spud machinery, and spring lines; and, above all, of a more carefully trained drill and boat crew. The elimination of troublesome equipment and the complete overhauling of a drill boat when laid up between working seasons will go far to prevent breakdown of the hull and machinery during the working season.



United States Government drill boats "Terrier" and "Teredo" at work deepening the Pacific entrance to the Panama Canal back in 1925.

RICHARD D. PURCELL

IT is with profound regret that we have to announce the passing, on September 20, of Richard D. Purcell, treasurer of Ingersoll-Rand Company. Following an attack of grippe, he had returned to his post of duty when death came unexpectedly. He had served the company for 45 years, and his loss will be keenly felt throughout the entire organization.

"Dick", as Mr. Purcell was affectionately called, was born on April 25, 1873, in New York City, where he acquired his schooling. In September of 1888, when he was fifteen years of age, he was employed as messenger by the Ingersoll Rock Drill Company, then located at Ninth Avenue and Twenty-seventh Street, New York City. That was the beginning of a splendid career—a career that is a shining example of what can be achieved through intensive industry and loyalty.

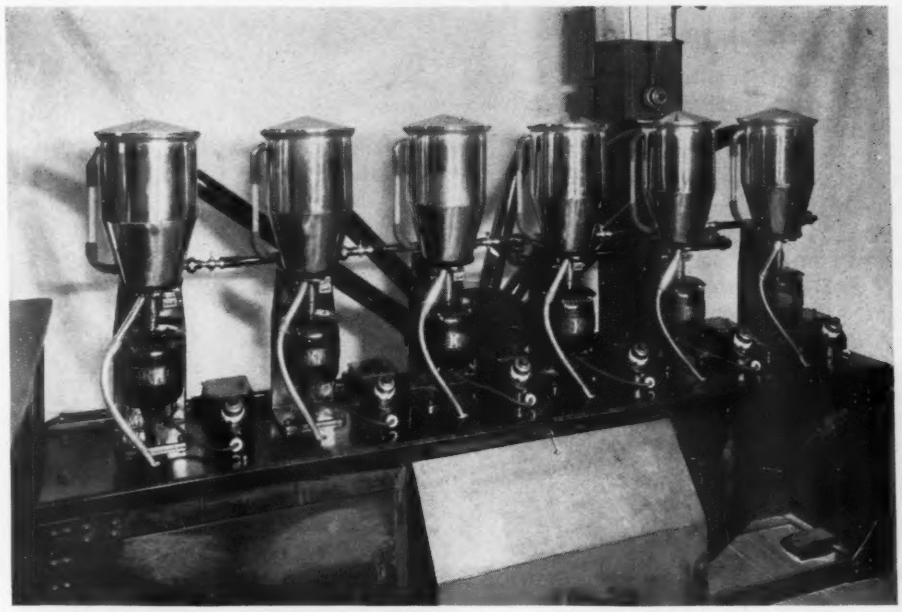
From messenger in the old Ninth Avenue shops "Dick" was soon advanced to invoice clerk and from that position to assistant cashier, and on December 18, 1906, eighteen years after he had entered the company's employ, he became assistant treasurer. On May 18, 1920, he was elected treasurer. He was also a director of the Ingersoll-Rand Company.

Mr. Purcell's soundness of judgment peculiarly fitted him for his duties as treasurer. Examples of his invariable justice and kindness are many and noteworthy. He endeared himself to those that came to him in their distress by his ability to anticipate their needs and to those that sought his counsel by his acts of thoughtfulness. He was a staunch friend to everyone who played fair, and would go out of his way to be helpful. His sterling qualities, together with a keen sense of humor, won for him not only the recognition of the company he served so long and faithfully but the respect and esteem of his coworkers and friends.

Mr. Purcell was a resident of East Orange, N. J. He is survived by his widow, Mrs. Anna Purcell, and by five daughters and three sons.

POWDERED GYPSUM FOR ROCK-DUSTING

POWDERED gypsum is recommended for dusting in collieries to prevent explosions or the spread of fire. As compared with stone dust now commonly used for this purpose, gypsum is more conspicuous because of its whiteness; it has a high moisture content that enables it to absorb 50 per cent more heat at 1,832° F. and 90 per cent more at 932° F.; and in the case of hot afterdamp it tends to convert carbon monoxide almost entirely into dioxide. Besides these advantages, says *Kohle und Erz*, gypsum does not induce silicosis or other similar disorders of the lungs but acts as a prophylactic against tuberculosis.



Courtesy, Bell Telephone Laboratories

Machines Gauge Wearing Quality of Finishes

EXPERTS of the Bell Telephone Laboratories have developed an apparatus that makes it possible to test lacquers and other finishes for their relative resistance to handling and to mechanical wear. While designed primarily for selecting surfacing materials for telephone instruments, the equipment should prove of value in numerous other directions because the information furnished by it has heretofore not been readily available.

The machine consists essentially of a chamber containing a standard grade of sand in which a disk, which has previously been coated with the finish to be tested, is rotated at high speed. The disk is 4 inches in diameter, is mounted on top of a vertical shaft driven by a vertical motor, and is covered with 5 inches of sand. Either metal or wood disks may be used. The most satisfactory speed for the former is 1,000 revolutions per minute; but for the latter, because of their tendency to warp, it is only 750 revolutions per minute. There are six of these units in the Bell Telephone Laboratories.

During testing, the sand is kept in circulation by compressed air, which is injected through a small-diameter pipe entering the bottom of the chamber. Thus the abrasive immediately in contact with the disk is changed continually, the air forcing it to the top of the pile by way of an outside tube connection. This tube was originally made entirely of metal; but it is now provided with rubber bends because the impact of the sand at those points quickly cut through the metal. Light waste material is drawn up and out of the chamber by suction which, together with the compressed air, tends to cool the surface that is being subjected to the abrasive action of the sand. After each test approximately 25 per cent of the sand is renewed.

To get consistent results, the disks should be alike in all respects and the films should be uniform in thickness. This means that in testing different makes of a certain kind of finish there should be little variation in the thickness not only of each film but of the films on the competitive disks. Care must therefore be exercised in applying the surfacing materials, especially the quick-drying lacquers. Experience has proved that, with little practice, the air-spray gun can be counted upon to provide films that are thoroughly satisfactory in this respect.

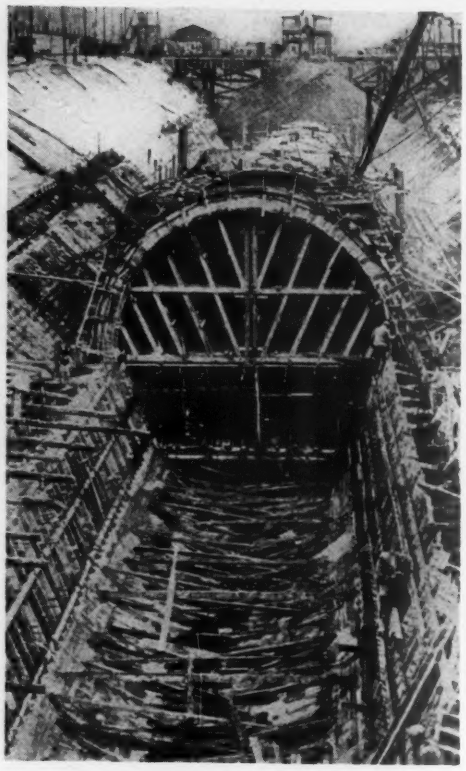
As explained by Mr. R. Burns, of the Telephone Apparatus Development Section, "The speed of the surface of the sample relative to the sand varies directly with the distance out from the center of the shaft. The wear, in other words, increases progressively towards the periphery of the disk. Under standard conditions of sand and speed, therefore, the distance from the center to the line of wear is a measure of the ability of the finish to withstand mechanical wear. By multiplying this distance by the number of revolutions the sample makes, a wear index is obtained which is a very satisfactory gauge of wear resistance." For example, the wear index of inexpensive bronzing liquids carrying aluminum powder was found to be "one"—that is, by the time the disk had run a minute, made 1,000 revolutions, the wear line was about half way out towards the periphery of the disk. On the other hand, a 2-coat japan finish .0005 inch thick had a wear index in the neighborhood of "fifteen" because the same wear line was not reached until after the disk had been run for fifteen minutes.

INSTRUMENT TESTS SOUNDNESS OF RIVET HOLES

THE old saw that "a chain is as strong as its weakest link" has universal application and is generally recognized. Therefore, industry has given to the research man the task of preventing weak spots and of providing it with means and methods that will reveal flaws that are inaccessible or that cannot be detected through inspection with the naked eye. An instrument for this purpose has been devised recently and is designed to bring to light any incipient cracks in rivet holes that may lead to failure on the part of fabricated steel. The instrument was developed by the National Boiler & General Insurance Company, Ltd., of Manchester, England; and while intended primarily for the boilermaker it can be used on any riveted steelwork.

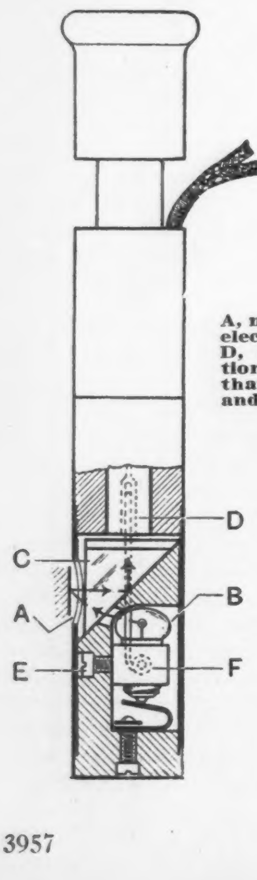
When there is doubt as to the soundness of a joint, it is the common practice to punch out a rivet or rivets. There is nothing hard about that; but in the past it has been troublesome to study the surfaces of the holes with any degree of accuracy, particularly if the plates were thick. This difficulty, says the London *Engineer*, has been overcome by the aforementioned device, which is in the form of an inverted periscope.

The instrument is housed in a tube small enough to be inserted in a hole of 7/8 inch diameter, and permits making an examination of the entire plate surface that has been in contact with the rivet. This can be done rapidly, because the field of vision is a limited one. As the metal under scrutiny is strongly illuminated by an electric lamp and is magnified seven times, even the most minute crack is visible after the surface has been suitably prepared by first filing it smooth, polishing with emery cloth, etching with nitric acid, and washing with water or with a solution of soda to neutralize the acid. In case there is any question as to whether or not there is a crack in the rivet hole, further polishing and etching are necessary.



Photo, Acme

Tunnel building in Antwerp. The project is one of major importance and is the first of its kind to be undertaken in Belgium. The section illustrated is an open-cut approach to one of the two subaqueous tunnels that are being driven beneath the Scheldt.



A, magnifying lens; B, electric lamp; C, prism; D, electrical connections; E and F, screws that hold lamp socket and facilitate renewing bulb.

PIPE-CARRYING MOTOR TRUCK OF SPECIAL DESIGN

WHAT is said to be the first motor truck of its kind has been built for the Burmah Oil Company, Ltd., and is designed for the transportation of pipes and to assist in their handling in isolated places such as are frequently traversed in laying pipe lines. The truck has a capacity of 7 tons, and can carry pipes up to 4 feet in diameter and 40 feet in length. These it can load and unload without the aid of a crane.

To accommodate pipes of such length, the cab has been made to seat one man comfortably, leaving sufficient room on either side so that they can extend the full length of the truck. Longitudinally disposed on the floor of the vehicle and in line with the sides of the cab are four bolsters against which the pipes rest in transit. Each bolster is provided with three clamps, and these hold the separate layers of pipes in place without lashing and serve also as supports or beds for the two uppermost tiers. These clamps are adjustable so that pipes of varying lengths and diameters can be transported with equal facility.

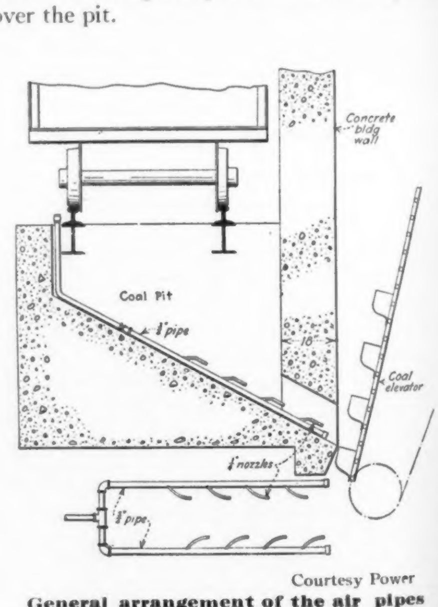
Loading and unloading is done mechanically by the aid of hawsers winding around niggerheads located on each side of the chassis and just below the cab level. When loading the far side the nearby niggerhead is used, the hawsers passing over rollers on their way up through holes in the center of the floor and down the side of the truck, where they form slings in which the pipes are hauled up ramps when the niggerhead is set in motion by the truck driver. Round bars of iron, each weighing approximately half a ton, have thus been loaded in from 1/2 to 1 minute. For unloading, the niggerhead is reversed.

By removing the bolsters, the floor of the vehicle can be cleared for the carriage of heavy machinery required for pipe-laying. This is handled by means of a special winch under the driver's seat. This winch can exert a straight pull of seven tons in either direction, hauling the loads up or down ramps placed at the end of the truck. Because of the obstructing pipe lengths, the cab has no side doors. Ingress and egress are offered the driver through the back that is hinged to form a door or, when that too is blocked, through the roof in which there is a covered opening. The motor truck was built in England by the Leyland Motors Limited, and the prospects are that it will have a wider field of usefulness than that for which it was intended.

COMPRESSED AIR FEEDS COAL DUST TO ELEVATOR

IN a plant in Wilkes-Barre, Pa., which burns a fine dust-like grade of anthracite, compressed air is used to feed the coal from the pit to the elevator. The original plan of the pit did not include air feed; but it was installed later because the coal packed at the opening leading to the elevator and hampered unloading.

As the drawing shows, two paralleling pipes extend down into and along the bottom of the pit to the opening, where eight nozzles inject the air in the same direction as that followed by the coal. As a result, the coal is kept flowing freely to the elevator all the while it is being dumped from the car spotted over the pit.



Courtesy Power

General arrangement of the air pipes and nozzles in the coal-unloading pit.

AIR-OPERATED BENCH VISE

A QUICK-ACTING pneumatic bench vise that helps to keep up the pace set by the machinery used in conjunction with it has been designed and built by Messrs. Alfred Herbert, Ltd., of Coventry, England, makers of machine tools. The vise has an over-all length of 21½ inches, and consists in the main of an air cylinder and sturdy jaws fitted with renewable hardened steel grips. The jaws are 4½ inches wide, 3½ inches deep, and have a maximum opening of 5½ inches. The jaws can be adjusted rapidly to suit any thickness of work within these limits by turning a knob on the front of the movable jaw. Normally the jaws remain fixed: they are reset only when the work is changed or when articles are handled that vary more than ½ inch in thickness.

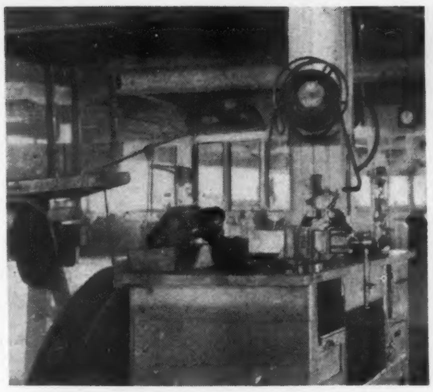
The operation of the plunger that forces the movable jaw in or out is effected by either

Herbert air-operated bench vise showing dual system of control.

hand or foot control—the latter leaving the worker's hands free to lift heavy pieces or to insert one piece after another without laying down the finishing tool. With air at 80 pounds pressure the vise exerts a grip of ¾ ton. The air supply and, incidentally, the grip can be regulated, if desired, by the use of a reducing valve and a pressure gauge so that fragile work can be held in the vise without distorting it.

PORTABLE WORK BENCHES IN WEST COAST UTILITY GARAGE

IN ITS San Francisco garage, the Pacific Gas & Electric Company has reversed the usual procedure of installing service outlets convenient to principal working points. In this instance, work benches are made portable, permitting them to be moved from place to place as required. Compressed air, water,



One of the work benches and building columns equipped to supply air, water and electricity.

and electric lines are run to building columns where they are readily accessible but not in the way. The accompanying illustration shows a bench in position alongside a compressed-air line. All benches are covered with 16-gauge boiler plate so that heavy hammering may be done on them. Compartments having sliding doors are built into the benches for the storage of large and small tools.

QUARRYING FOR SAND AND GRAVEL

SECONDARY shooting does not often have to be practiced in a sand and gravel pit; but, where it does, the work can be done quickly by the use of "Jackhamers" and a portable compressor. At least, that is the experience of the Makins Sand & Gravel Company, which is operating deposits in Sulphur, Okla. These deposits, as well as those in the surrounding country and in the Panhandle district of Texas, consist of a cemented conglomerate. This material cannot be handled in the ordinary way; and the pit is therefore being worked more or less like a quarry.

The gravel is brought down by churn drilling and blasting; and even this does not always suffice to break it up into pieces small enough for the primary crusher. While the amount of secondary shooting required is not large, still the "Jackhamers" and the portable have proved themselves to be best suited for the work. Another innovation is the use of a Fordson tractor to haul the compressor to the various points of operation. The Fordson is as handy for this purpose as it is for the many other services it performs about the pit.

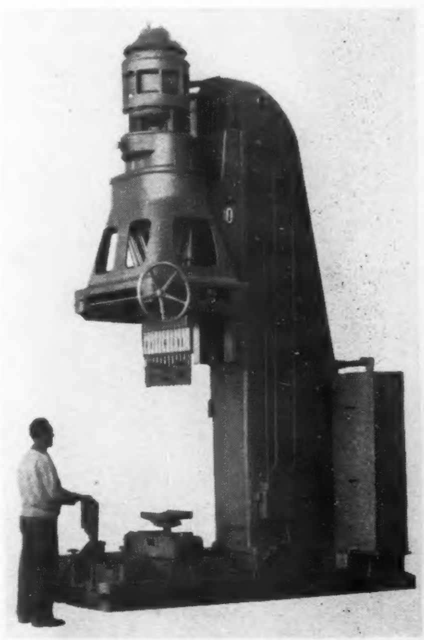
Courtesy Rock Products

In the Makins sand and gravel pit, showing the portable and Fordson that help to do secondary shooting.

AIR JACK HOLDS WORK IN HYDRAULIC DRILL

HEAVY equipment is required to drill tube holes in large express-type boiler drums. For this work the National Automatic Tool Company, Richmond, Ind., has recently built a hydraulic vertical drilling machine—an adaptation of an earlier model—that stands 16 feet high and weighs about 38,000 pounds. It is capable of drilling twelve 1½-inch holes in steel at heavy feed.

The spindles are held in a special adjustable bearing plate and are arranged in a straight line parallel to the column. They can be shifted horizontally a matter of 14 inches—the minimum distance between them and the column being 22 inches. To support the large steel drums during drilling, a pneumatic jack is mounted on the base of the machine. This jack is operated by means of a treadle valve—the compressed air admitted to the cylinder forcing in a 7° angle wedge that gives the jack a lift of ½ inch.



Heavy-duty drill machine showing the air jack directly below the spindles.

SEPARATOR FOR LUBRICATING OILS

MAKING lubricating oils fit for reuse is the task cut out for a new type of separator recently put out by the British Separators, of York, England, and distributed in Canada by the Crude Oil Engine & Engineering Company. The separator is small and self-contained, and comes in five sizes ranging in capacity from 5 to 350 gallons per hour, depending on the kind of oil treated.

According to the manufacturer, the Vickcen separator can handle any kind of machinery, air-compressor, diesel-engine, steam-turbine, and transformer oil at a cost varying from 1½ cents a gallon for automobile oil to less than one cent a gallon for compressor and similar lubricants. The reclaimed oil contains no dirt and no water; is free from oxidation; and retains all its lubricating properties.

Peat is said to be the base of a soundproof material being manufactured by a new process.

Oil storage tanks in the United States have a total capacity of approximately 1,000,000,000 barrels.

Rubber flooring will prevent dirt or fines from sticking to the bottoms of mine skips and cars.

Reduced to a standard width of 20 feet, the concrete roads in Great Britain and Ireland in 1931 aggregated 1,540 miles, an increase of 1,358 miles in five years.

Alginates made from seaweed are being extensively used in France, we are told, for waterproofing concrete. The alginate is added to the concrete, producing alginate of calcium that is insoluble in either fresh or salt water.

Gallium, one of the rare metallic elements found in minute quantities in iron ore, has latterly been isolated in Germany by a method that has cut the cost of its production from about $35 to less than $2 a gram.

About 50,000 acres of rice were planted in the Sacramento Valley of California by airplane in 1931. Twelve machines, equipped with special hoppers and spreaders, were used for the work.

In preparing the rock foundation for the dam and power house of the great Dnieprostroy hydro-electric project in south-central Russia, an aggregate of fifteen miles of drill holes was sunk and grouted with 660 tons of cement.

By the use of the photo-electric cell, more commonly known as the electric eye, it is possible for a forester to determine how closely to replant trees. This the device enables him to do by measuring the sunlight reaching the ground.

The German state railways, which began to standardize some years ago on a 100-foot rail, are now experimenting with rails almost double that length. Forty miles of tracks are said to have been equipped with the 197-foot test rail.

Courtesy, The Pfaudler Company

This formidable array of air jacks makes sure that the long steel plate undergoing beveling is clamped tight in the traveling carriage. The plate is subsequently rolled into a cylinder and used in the fabrication of large storage tanks for milk.

To the numerous list of protective coatings on the market has been added another by the Liquilox Company, Ltd., of Los Angeles, Calif. The product can be applied by hand or by the spray gun to hot or cold surfaces, and is said to be proof against all acids, alkalies, salts, and against indirect heat up to a temperature of 1,500° F. It is black in color, but can be supplied in shades of bronze.

Power plants burning pulverized coal can be kept clean. A shining example of this is the Copper Cliff refinery of the International Nickel Company in Canada. All the steel work and equipment is coated with aluminum paint to reveal dirt, and a central vacuum-cleaning system has been installed. This is used every day, with the result that the place is as neat as the rest of the power plant.

Under the name of Jersey Abraso EE spring steel, the John A. Roebling's Sons Company has put out an abrasive-resisting wire for heavy-duty vibrating, rotary, shaking, and gravity screens. The alloy steel is made by a special process, and comes in screening ranging from 6¼-inch openings down to 18 mesh. It is said to stand up well under severe service conditions.

A new aluminum alloy that can be given the various shades of gold that distinguish the different carats has been discovered more or less accidentally, so it is reported, in the Sheffield District of England. It is a nonferrous alloy of aluminum and copper that does not readily tarnish nor corrode. The process is being utilized to treat brass and copper parts of machinery designed for work in exposed places.

The giant airship *Akron* of the United States Navy is equipped with continuous carbon-monoxide indicators that can detect the deadly gas when present in percentages as low as 0.01. The airship is heated by means of a system of coils and pipes that are led over the exhaust manifolds of the engines. To these ducts are connected the sampling lines of the indicators which, as soon as a leak occurs, flash a red light in the engine compartment and sound a buzzer in the control car.

By automatically controlling the temperature of pickling solutions used in removing scale from wire rods, it is possible, so information has it, to effect a saving in acid consumption as well as largely to prevent the generation of harmful fumes. By the method as devised in a New York plant, steam for heating and agitating the bath is injected into the tank through a pipe that is disposed vertically in one corner of it and fitted with an air-operated valve. This valve is regulated automatically by means of a recording instrument that is set to function at a temperature of 180° F. When the temperature of the solution drops below this predetermined point the valve is opened, causing steam to flow through the pipe and into the bath until the latter's normal temperature has been restored. The valve is again automatically closed as soon as this has been done.

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